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# NATION-WIDE INVENTORY OF SANITATION NEEDS

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Public Health Service
Washington, D. C.

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# Nation-wide Inventory of Sanitation Needs

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## FOREWORD

Over the years, the public health movement in America has been alined closely with community efforts to achieve a healthier place in which to live. Our ability to conquer epidemics of typhoid, dysentery, and other filth-borne diseases is a direct result of improved community sanitation.

Despite its importance as a foundation stone of public health, however, we have been forced to work with only incomplete statistical data on sanitation needs. In 1946, it was possible for the United States Public Health Service to embark upon an intensive survey of existing facilities in cooperation with State and local health departments. The resulting report contains information culled from innumerable field studies made in all parts of the country. Conclusions stated in the text represent the valid opinions of men long skilled in the field of sanitary engineering.

This basic work should serve as a valuable guide for national, State, and local planning in the fight against disease caused by unsafe supplies of water and milk. It represents the first evaluation of our sanitary facilities on a national scale by actual field investigations. Concerted action in satisfying the needs outlined in the report should take us a long way toward providing a safe environment in which everyone may live.

LEONARD A. SCHEELE, *Surgeon General,*
*United States Public Health Service.*

# NATION-WIDE INVENTORY OF SANITATION NEEDS

## INTRODUCTION

In 1944 the United States Public Health Service outlined a six-point program for the conservation of our most valuable natural resource, the health of the American people. Heading the list was a sanitary environment for everyone. As its position in this proposed national health program implies, a safe and healthy environment is a prerequisite to most other activities aimed at preserving and improving the public health.

As a Nation we can be proud of our progress in making our country a healthful place in which to live. While much of the scientific research upon which modern sanitation is based was done during the nineteenth century, most of the progress in improving health through sanitation has been made since 1900. Although there were some 3,200 public water supplies in the country at that time (*1*) and the water-borne nature of typhoid fever and other diseases was well known, purification plants were few, the quality of the water generally poor, and death rates from water-borne diseases were high. Today, more than 14,000 systems provide water to about 85 million people, and the quality of the water furnished is generally excellent.

In places where water-carried sewerage systems are not available, the privy has been the standard method of excreta disposal. Although this structure is of ancient origin and has received considerable architectural attention, its sanitary design was long neglected. In 1909 the Rockefeller Sanitary Commission was established to combat hookworm disease. Installation of properly designed sanitary privies was the principal preventive measure employed.

Death rates from the filth-borne diseases such as typhoid fever, dysenteries, and diarrhea-enteritis have declined dramatically with improved sanitation. In 1900 over 23,000 people in the United States died of typhoid fever and more than 100,000 deaths were due to diarrhea-enteritis and dysenteries. In 1944 the deaths from typhoid fever were less than 600 and deaths from the other enteric diseases had dropped to about 15,000.

With the progress that has been made in reducing mortality from these and other communicable diseases, which were the first to receive the attention of public health workers, other health problems have emerged which demand increasing attention. But we must not lose sight of the fact that our fight against the diseases of insanitation is a

continuing one. The protective barriers that we have erected must be maintained and reinforced. The increasing complexity of our civilization constantly brings new health hazards which must be met. On the other hand, there are still many parts of the country where the incidence of the filth-borne diseases is high and where comparatively little progress has been made toward improving sanitation.

We have come to realize that health is not the mere absence of disease but a positive state of body and mind which is conducive to a full and productive life. This concept of health requires that environmental sanitation include more than the mere prevention of disease by measures directed at man's environment. It must also include those measures which tend to improve positive health even though they may not be concerned directly with disease prevention. This concept of sanitation has guided our efforts in this study of the Nation's needs for sanitation facilities.

Sewerage systems had been built in cities with a total population of 25 million in 1900, but there were only 60 sewage treatment plants, serving about 1 million people (*2*). Today, more than 70 million people are served by sewerage systems, and more than 5,500 treatment plants have been installed, which serve about 42 million people. Methods for disposing of garbage and other refuse were generally haphazard at the turn of the century. In many large cities this service was handled entirely by private contractors with little or no supervision from health authorities. Today, practically all of our larger cities, and a constantly increasing number of the smaller ones, provide regular collection service of garbage and refuse, and disposal methods have been improved.

Although the work of Pasteur upon which milk pasteurization is based was done during the 1860's, it was not until 1906 that Dr. M. G. Rosenau of the United States Public Health Service determined the thermal death points of various pathogens in milk and laid the foundation for scientific milk pasteurization for the protection of health. The first commercial plant installed in conformity with this information was made in 1907 (*3*). Today, more than 70 percent of our market-milk supply is pasteurized.

During 1943 the Sanitary Engineering Division of the United States Public Health Service undertook a preliminary inventory of the Nation's sanitary needs in the fields of public water supply; sewerage and pollution abatement; milk pasteurization; and rural water supply and sewage disposal. These were published during 1944 in Public Health Reports (*4, 5, 6, 7*). In general, that inventory was based on information available at the time in the offices of the United States Public Health Service.

The present survey was undertaken to obtain a clearer picture of the Nation's needs than was possible in the 1943 inventory, to indicate the areas where needs are greatest, and to point out lines along

which action should be taken. This survey represents the first attempt that has been made on a national scale to evaluate our needs for sanitation facilities on the basis of actual field investigations. It is hoped that the results will prove useful to State and local health workers, and to all others—public officials and private citizens—interested in protecting and improving our nation's health.

## SUMMARY

1. The cost of needed water supply and waste disposal facilities for the United States is estimated at $7,834,581,000 (table 1).

TABLE 1.—*National cost estimates for needed sanitation facilities, 1947 (costs in thousands of dollars)*

| Type of facility | Ready for construction | Planning in progress | Projects for future | Total |
|---|---|---|---|---|
| Water | 385,591 | 608,349 | 1,275,042 | 2,268,982 |
| Sewerage | 360,509 | 908,048 | 2,480,296 | 3,748,853 |
| Garbage and refuse disposal | | | 166,526 | 166,526 |
| Rural sanitation | | | 1,650,220 | 1,650,220 |
| Total | 746,100 | 1,516,397 | 5,572,084 | 7,834,581 |

2. Approximately 2,360,000 people in 5,710 communities with no public waterworks systems need such facilities (fig. 1). Almost 15,000 communities with over 79 million people have waterworks which need improvements or extensions. In rural areas where community systems are impracticable, 27 million people need either new or improved water supplies.

3. More than 9,100 towns with 6,360,000 people need complete sewerage systems (fig. 1). Some 9,900 additional communities with almost 80 million people have systems which need improvements. In rural areas, more than 33 million people lack satisfactory sewage or excreta disposal facilities of even the simplest type.

4. In 8,300 communities with 70 million people, there are needs for better facilities for collecting and disposing of garbage and other municipal refuse.

5. More than 36 percent of the community needs are either ready for construction or in the planning stage. Two-thirds of the work which is ready for construction, and more than half which is being definitely planned, is in cities of 100,000 or more. In cities of over 5,000 population almost half of the needed work is at least at the planning stage. In the smaller towns much less advance planning has been done.

6. Much of this needed construction is a backlog of work which developed during and after the war. Materials shortages, rapidly rising construction costs, and an unwillingness of local governments to enter into competition for materials and labor necessary to meet the acute housing shortage, have made most communities continue

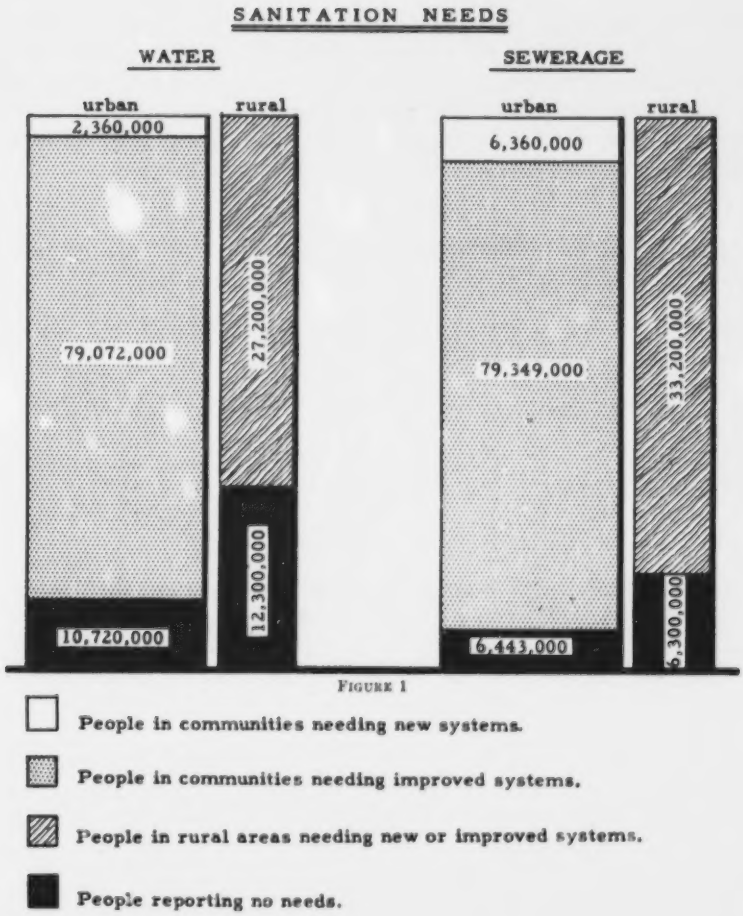



FIGURE 1

to defer all except emergency work. As conditions in the construction industry return to more nearly normal, this backlog of needed work should proceed at an increasingly rapid rate. During the first half of 1947 the volume of waterworks and sewerage construction reached 120 million dollars, almost 30 percent above the comparable period in 1946.

7 The per capita cost of needs varies from $23 in Rhode Island to $107 in New York State and averages about $60 for the Nation as a whole (table 3). The high cost of the needed work in some of our large cities is reflected in some of the large State totals. Water supply and sewerage needs of New York City will require an expenditure of over $1,000,000,000; Philadelphia about $450,000,000; Chicago

$220,000,000; Detroit $150,000,000; St. Louis $85,000,000; Pittsburgh and Allegheny County $80,000,000; Denver $70,000,000.

8. The per capita cost of needs is greatest in the smallest communities and in the largest ones. In towns of less than 1,000 population, needs exceed $100 per capita, while in cities of over 1,000,000 they approach $120 per capita. However, a much larger proportion of income will be required in the smaller towns than in the wealthier big cities.

9. In the fringes of most of our metropolitan areas, houses with inadequate sanitary facilities are being built which promise to become the slums of tomorrow. State legislation to enable counties to adopt and enforce suitable zoning laws are badly needed, as well as additional personnel in the local and State health departments who can deal with the sanitation problems of these rapidly growing areas.

10. Educational work and technical advice are needed to assist the small communities in obtaining the water and sewerage facilities they should have. This will require additional personnel in the State health departments. In some States improved laws are necessary to facilitate the formation of sanitary districts. In other States the laws providing for revenue financing of sanitation facilities need revision to make them more usable. Financial assistance in the form of low-interest loans would give impetus to the installation of needed community facilities. These small towns and the rural areas deserve special attention since it is in them that the incidence of the filth-borne diseases is highest and serve as focal points of infection from which these diseases can spread.

11. It is in the rural areas beyond the reach of any practicable community facilities that the greatest shortage of sanitation facilities exists. Although this is due to some extent to a lack of money, it is also due to a lack of realization of the dangers involved. Local health departments are lacking in many of these areas and are understaffed in most of them. Extension of adequate local health services to these areas is a prime necessity.

## PURPOSE AND SCOPE OF SURVEY

The preliminary survey of sanitation requirements made during 1943 pointed out the fact that the country had certain important needs for sanitation facilities. The present survey was undertaken to define these needs more clearly than was possible during the 1943 survey.

In this way we hope to establish a marker along the road of progress toward our goal of a sanitary environment for everyone. We know and are proud of the fact that as a Nation we have made tremendous progress toward that goal in the past 50 years. We know with a fair degree of accuracy what facilities we have. But we lacked information on the shortcomings of these facilities. We knew also that there were

great variations in the adequacy of sanitation facilities within various States and between various States and regions. But we did not know how great these variations were.

The findings of this survey should assist health authorities to direct their efforts along lines of greatest need. The findings should also be of value to various public officials engaged in providing sanitation facilities. Finally, the survey should provide a reference point for measuring future progress.

A sanitary environment comprises many elements. Of these, a safe and adequate source of water supply and a sanitary method of disposing of wastes are universally recognized as indispensable. In a modern urbanized society a breakdown of these facilities is a major catastrophe. The scope of this inventory is limited to determining the needs of the people in these fields, namely, water supply, sewerage and sewage treatment, and refuse disposal.

It was desirable to limit the scope of the inventory in order to cover the selected fields in the most satisfactory manner. It should not be inferred that these needs are the only ones which must be satisfied in order to insure a sanitary environment.

Healthful housing is a most important factor in maintaining a sanitary environment. A complete study of environmental sanitation including housing has never been attempted on a national scale. One of the most important deterrents to such study is the lack of suitable objective standards for measuring the quality of housing. A noteworthy advance in this direction has been made recently by the Committee on the Hygiene of Housing of the American Public Health Association in developing an appraisal method for measuring the quality of housing *(8)*. A thorough appraisal of housing needs, using some such objective standard, is long overdue.

Insect and rodent control requirements have not been included in this inventory. To a considerable extent they are related to other sanitary needs. Adequate housing, sewage disposal, and garbage disposal methods play important roles in dealing with the health problems due to insects and rodents. New insecticides and rodenticides such as DDT and "1080" are extremely valuable weapons against these pests which also transmit disease.

Sanitary methods of producing, handling, preparing, storing, displaying, and serving foods are essentials to healthful living. To a considerable extent this presents a problem of education. In addition, adequate facilities are required in food processing and handling establishments, as well as in the home. No attempt has been made to inventory the needs for facilities of this type.

The previous national inventory of needs for sanitation facilities included those for the pasteurization of milk. Where pasteurized milk is available, public demand stimulated by diligent health education usually results in a steady increase in its use. Approximately 500 American communities now require the pasteurization of all milk

or all except certified milk. But in many communities, especially the smaller ones, no pasteurized milk is available. In the previous inventory, estimates were made of the cost of providing pasteurization plants for all communities or groups of neighboring communities of over 2,000 population in which no pasteurized milk was available.

On the above basis it was estimated that 438 milk pasteurization plants of various sizes were needed in 34 States and Alaska and that the total cost at 1942 price levels would be slightly more than $8,000,000. In collecting the data for the present inventory, revised information was obtained showing the pasteurization plant needs as of 1945. Because of the relatively minor changes in the situation since 1943, these facilities have not been included in the present inventory, although the need for additional plants has not been met.

## METHODS

This survey was made with the close cooperation of the State health departments which furnished much information on the needs of specific communities and rural areas. In addition, field surveys were made by trained sanitary engineers in individual communities to inspect local facilities, to confer with local officials regarding proposed work, to review plans, and to obtain first-hand information on various aspects of the sanitation problem. In the absence of well-defined plans, the engineer made a reconnaissance survey to obtain sufficient data to make an engineering estimate of the cost of the work. Where estimates by consulting engineers were available, these were used with price adjustments to reflect current costs. The field work was started in the latter half of 1945 and completed in March 1947. The status of some of the work has changed since the surveys were made. Projects that were only ideas entered the planning stage. Some of those being planned at the time the community was surveyed, are now either ready for construction or are actually being built. These changes are inevitable and make it impossible to keep information on the status of projects up to date.

### SAMPLING

Since it was impracticable to survey each of the 27,000 incorporated and unincorporated communities in the country and all rural areas, a sampling technique was adopted. Communities within each State were arranged in eight groups according to population. These eight population ranges were: 200–500, 500–1,000, 1,000–5,000, 5,000–10,000, 10,000–25,000, 25,000–50,000, 50,000–100,000, and over 100,000. A sample of the towns in each of these groups was surveyed. Emphasis was placed on obtaining information in all of the larger communities, rather than attempting to maintain a uniform percentage sample in each population group. Table 2 shows the percentage of the total population in each group which was actually surveyed.

Virtually all cities of over 25,000 population were covered. Estimates of total requirements of communities in each size group in each State, were obtained by using a ratio of the population of all communities in a particular population range, to the population of the surveyed communities. Populations were obtained from the 1940 census for all incorporated communities and for such unincorporated communities as were reported on by the Census Bureau. In the absence of these official figures, the populations reported in the Rand-McNally atlas were used. It was recognized that there have been appreciable changes in population of many communities since 1940 but, in the absence of reliable data on these changes, it was considered preferable to use the census data rather than local estimates of unknown and varying accuracy.

TABLE 2.—*Percent of population in communities surveyed, by States and by size of community*

| State | Population of community | | | | | | | | All communities |
|---|---|---|---|---|---|---|---|---|---|
| | 200–500 | 500–1,000 | 1,000–5,000 | 5,000–10,000 | 10,000–25,000 | 25,000–50,000 | 50,000–100,000 | Over 100,000 | |
| Alabama | 91.5 | 32.8 | 27.2 | 94.0 | 100.0 | 100.0 | | 100.0 | 71.4 |
| Arizona | 29.2 | 69.1 | 100.0 | 100.0 | | 100.0 | 100.0 | | 89.2 |
| Arkansas | 14.8 | 29.3 | 31.2 | 100.0 | 100.0 | 100.0 | 100.0 | | 61.2 |
| California | 9.5 | 25.6 | 28.2 | 49.5 | 42.5 | 91.0 | 88.0 | 100.0 | 78.0 |
| Colorado | 40.8 | 69.6 | 89.4 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 92.5 |
| Connecticut | 70.9 | 42.5 | 38.8 | 69.5 | 100.0 | 100.0 | 100.0 | 100.0 | 89.0 |
| Delaware | 52.4 | 100.0 | 100.0 | 100.0 | | | | 100.0 | 97.5 |
| District of Columbia | | | | | | | | 100.0 | 100.0 |
| Florida | 10.6 | 35.0 | 35.1 | 93.5 | 94.5 | 100.0 | 100.0 | 100.0 | 80.5 |
| Georgia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Idaho | 57.2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | | | 90.5 |
| Illinois | 6.6 | 14.6 | 15.5 | 48.3 | 71.3 | 100.0 | 100.0 | 100.0 | 80.0 |
| Indiana | 8.5 | 9.0 | 18.7 | 72.0 | 95.5 | 100.0 | 100.0 | 100.0 | 76.0 |
| Iowa | 12.7 | 17.1 | 21.5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 67.2 |
| Kansas | 13.5 | 24.6 | 32.8 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 70.9 |
| Kentucky | 10.7 | 26.8 | 31.9 | 96.4 | 100.0 | 100.0 | 100.0 | 100.0 | 71.0 |
| Louisiana | 7.7 | 17.8 | 15.9 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 74.0 |
| Maine | 29.5 | 52.6 | 80.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 87.0 |
| Maryland | 6.0 | 4.0 | 0 | 34.0 | 64.5 | 100.0 | 100.0 | | 82.5 |
| Massachusetts | 70.9 | 93.0 | 23.7 | 53.4 | 63.6 | 91.8 | 88.5 | 100.0 | 80.9 |
| Michigan | 9.8 | 13.2 | 14.5 | 64.1 | 91.8 | 100.0 | 100.0 | 100.0 | 82.5 |
| Minnesota | 12.1 | 22.8 | 23.0 | 83.3 | 100.0 | 100.0 | | 100.0 | 75.5 |
| Mississippi | 8.3 | 12.7 | 17.1 | 100.0 | 100.0 | 100.0 | 100.0 | | 59.5 |
| Missouri | 10.5 | 26.7 | 25.4 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 82.0 |
| Montana | 34.9 | 86.3 | 97.9 | 100.0 | 100.0 | 100.0 | | | 91.0 |
| Nebraska | 18.2 | 30.7 | 31.5 | 100.0 | 100.0 | | 100.0 | 100.0 | 70.5 |
| Nevada | 37.9 | 80.5 | 100.0 | 100.0 | 100.0 | | | | 90.0 |
| New Hampshire | 37.2 | 22.3 | 43.2 | 100.0 | | 100.0 | 100.0 | | 73.3 |
| New Jersey | 13.2 | 67.6 | 20.2 | 42.8 | 100.0 | 100.0 | 88.5 | 100.0 | 74.0 |
| New Mexico | 58.0 | 95.5 | 91.0 | 100.0 | 61.0 | 100.0 | | | 92.5 |
| New York | 54.9 | 35.8 | 13.4 | 42.0 | 100.0 | 100.0 | 100.0 | 96.6 | 85.0 |
| North Carolina | 5.8 | 8.3 | 11.1 | 79.5 | 53.4 | 100.0 | 100.0 | 100.0 | 61.5 |
| North Dakota | 19.6 | 47.4 | 63.8 | 100.0 | 100.0 | 85.5 | 100.0 | | 62.5 |
| Ohio | 4.5 | 8.3 | 12.6 | 42.4 | 68.5 | 100.0 | | | 77.5 |
| Oklahoma | 15.7 | 30.0 | 28.0 | 100.0 | 77.5 | 100.0 | 100.0 | 100.0 | 74.5 |
| Oregon | 18.4 | 43.7 | 49.5 | 100.0 | 100.0 | 100.0 | | 100.0 | 81.5 |
| Pennsylvania | 2.6 | 22.0 | 7.2 | 36.5 | 100.0 | 100.0 | | 100.0 | 65.5 |
| Rhode Island | | 100.0 | 100.0 | 88.0 | 48.4 | 82.1 | 92.6 | 100.0 | 99.3 |
| South Carolina | 23.4 | 35.5 | 33.3 | 86.5 | 100.0 | 100.0 | 100.0 | 100.0 | 68.0 |
| South Dakota | 94.9 | 90.0 | 98.8 | 100.0 | 100.0 | 100.0 | 100.0 | | 97.7 |
| Tennessee | 2.6 | 10.6 | 9.8 | 100.0 | 100.0 | 100.0 | | | 74.5 |
| Texas | 6.1 | 16.5 | 15.2 | 61.8 | 85.0 | 100.0 | 100.0 | 100.0 | 68.0 |
| Utah | 62.0 | 89.5 | 90.5 | 100.0 | 100.0 | 100.0 | | 100.0 | 92.7 |
| Vermont | 44.5 | 48.7 | 48.3 | 86.1 | 100.0 | 100.0 | | | 64.5 |
| Virginia | 1.0 | 1.1 | 6.8 | 37.4 | 13.1 | 37.2 | 67.9 | 42.7 | 31.5 |
| Washington | 11.0 | 28.6 | 50.0 | 100.0 | 100.0 | 100.0 | | 100.0 | 82.5 |
| West Virginia | 5.3 | 6.6 | 8.1 | 83.5 | 100.0 | 100.0 | 100.0 | | 47.6 |
| Wisconsin | 9.8 | 5.8 | 23.2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 79.5 |
| Wyoming | 42.6 | 97.2 | 100.0 | 100.0 | 100.0 | | | | 93.5 |
| United States | 12.5 | 26.3 | 25.9 | 65.7 | 75.7 | 93.1 | 92.6 | 98.0 | 75.2 |

In estimating rural sanitation needs, a somewhat different system was followed. In some instances data were available from surveys of needs made by State and local health departments. Where this was not the case, field surveys were made of sample areas distributed throughout the State to give a representative sample. Actual conditions were observed and estimates made of the types of improvements, replacements or additions which should be provided. Estimates of the cost for each State were reached by multiplying the estimates obtained from the surveys, by the ratio of the total rural population to the population in the areas actually surveyed.

## DEFINITION OF NEEDS

In undertaking such an inventory as this, it is desirable to have some definition of "need." Although general agreement exists as to what constitutes a sanitation need, it has been found impracticable to define needs on a precise or uniform basis throughout the country. It would be desirable if every family in the country were provided with running water in its home, modern plumbing, and a sanitary method of disposing of garbage and other household wastes. This, however, must be considered an ultimate rather than an immediate goal. A program to accomplish these objectives in any short time would be unrealistic, since it would be dependent on a large number of antecedent changes in economic, cultural, and social patterns.

To a considerable degree, needs are related to local customs and conditions. Since it was desired that this inventory represent needs that can be met within a reasonable time by a practicable program and using techniques and equipment now available, it was decided that the concept of needs should take into consideration local desires and attitudes, policies of official State and local health agencies, and the economic condition of the community or area. The needs of a given community were determined by the field engineer making the survey, after consultation with State and local officials, and taking into consideration various pertinent factors. There was no inflexible criterion.

In general, public water supplies were considered practicable for towns as small as 200 population, unless the homes were too scattered or the cost of obtaining a safe potable water was too high for the community. Figure 1 includes in the urban group the population of all communities regardless of size in which a community water or sewerage system was deemed practicable. The difficulty and cost of obtaining satisfactory supplies for individual homes were important considerations in deciding whether a community system was needed. In general, communities of over 500 population find the financial burden of a public water supply much easier than the smaller towns. Public sewer systems also were considered for communities as small as 200 population. In addition to population concentration, topography plays an important part in determining the practicability of

public sewerage systems and in many places makes such systems unduly expensive.

In determining rural needs, it was considered that every home should have a source of water supply adequately protected against contamination and within a convenient distance from the house. Wells or other sources with either hand pumps or pressure water systems (generally with electric-powered pumps) were recommended, depending upon present practice, expressed plans or desires, and economic status. Sanitary privies or septic tanks with subsurface disposal systems were recommended for waste disposal, depending upon the availability of pressure water systems and the prevailing practice in the area.

### COSTS

This inventory was made during a period of steadily rising costs. This factor has complicated the job of preparing estimates. In order to be able to refer the data to some standard time to facilitate use of it under other cost conditions, an analysis was made of the survey reports which were prepared during 1945–47. It was found that on the average, the unit costs reflected construction costs of about June 1946. At that time the Engineering News-Record construction cost index was 348 (based on the average of 1913 costs as 100). The costs of various types of work are not uniformly affected by changes in the ENR index, but since it is the best one available for this use, it is given here. This index is much more applicable to public water supply and sewerage work than to the other types of work covered in this inventory.

## FINDINGS OF SURVEY

The results of the inventory are presented in a series of 10 tables. Tables 3 and 4 summarize costs; tables 5, 6, and 7 deal with waterworks needs; tables 8, 9, and 10 with sewerage works needs; table 11 with refuse disposal needs, and table 12 with rural sanitation needs.

The total cost of these needs amounts to more than 7.8 billion dollars, of which about 6 billion dollars are for individual water and waste disposal facilities. Refuse disposal needs amount to about 167 million dollars. (See table 3.)

TABLE 3.—*Estimated cost of needed water works, sewerage works, garbage and refuse disposal, and rural sanitation facilities, by States and size of community (costs in thousands of dollars)*

| State | Population 1940 [1] | Waterworks | Sewerage works | Garbage and refuse disposal | Rural sanitation | Total |
|---|---|---|---|---|---|---|
| Alabama | 2,833 | 16,482 | 31,171 | 1,171 | 81,492 | 130,316 |
| Arizona | 499 | 7,675 | 10,839 | 564 | 27,325 | 46,403 |
| Arkansas | 1,949 | 21,696 | 26,156 | 1,866 | 68,664 | 118,382 |
| California | 6,907 | 120,963 | 132,762 | 3,626 | 26,308 | 283,659 |
| Colorado | 1,123 | 85,179 | 10,447 | 703 | 10,535 | 106,864 |
| Connecticut | 1,709 | 20,120 | 39,194 | 3,797 | 7,644 | 70,755 |
| Delaware | 267 | 2,061 | 8,027 | 338 | 2,218 | 12,644 |
| District of Columbia | 663 | 41,427 | 11,228 | 2,372 | ---------- | 55,027 |
| Florida | 1,897 | 38,004 | 73,388 | 3,319 | 30,623 | 145,334 |

See footnotes at end of table.

TABLE 3.—*Estimated cost of needed water works, sewerage works, garbage and refuse disposal, and rural sanitation facilities, by States and size of community (costs in thousands of dollars)*—Continued

| State | Population 1940 [1] | Water-works | Sewerage works | Garbage and refuse disposal | Rural sanitation | Total |
|---|---|---|---|---|---|---|
| Georgia [2] | 3,124 | 22,071 | 48,050 | 2,682 | 104,200 | 177,003 |
| Idaho | 525 | 8,993 | 11,928 | 442 | 5,879 | 27,242 |
| Illinois | 7,897 | 138,259 | 236,536 | 7,842 | 106,320 | 488,957 |
| Indiana | 3,428 | 43,458 | 91,309 | 3,838 | 33,129 | 171,734 |
| Iowa | 2,538 | 32,698 | 66,242 | 1,864 | 59,420 | 160,214 |
| Kansas | 1,801 | 21,221 | 49,981 | 2,273 | 22,429 | 95,904 |
| Kentucky | 2,846 | 22,051 | 40,410 | 1,965 | 42,933 | 107,359 |
| Louisiana | 2,364 | 32,712 | 37,656 | 2,866 | 54,283 | 127,517 |
| Maine | 847 | 6,313 | 19,988 | 415 | 19,598 | 46,314 |
| Maryland | 1,821 | 45,485 | 43,606 | 2,575 | 10,458 | 102,124 |
| Massachusetts | 4,317 | 54,089 | 70,258 | 5,750 | 5,818 | 135,915 |
| Michigan | 5,256 | 134,842 | 153,096 | 4,771 | 30,940 | 323,649 |
| Minnesota | 2,792 | 45,805 | 56,252 | 4,214 | 32,264 | 138,535 |
| Mississippi | 2,184 | 11,366 | 20,892 | 1,372 | 44,330 | 77,960 |
| Missouri | 3,785 | 52,132 | 120,132 | 4,885 | 43,183 | 220,332 |
| Montana | 559 | 8,596 | 8,765 | 323 | 8,807 | 26,491 |
| Nebraska | 1,316 | 19,252 | 29,911 | 1,830 | 22,896 | 72,989 |
| Nevada | 110 | 1,868 | 2,204 | 148 | 1,351 | 5,571 |
| New Hampshire | 492 | 6,344 | 10,165 | 120 | 5,948 | 22,577 |
| New Jersey | 4,160 | 33,084 | 149,396 | 8,208 | 22,347 | 213,035 |
| New Mexico | 532 | 5,490 | 11,147 | 416 | 8,429 | 25,482 |
| New York | 13,479 | 247,182 | 1,100,303 | 38,890 | 61,075 | 1,447,450 |
| North Carolina | 3,572 | 52,720 | 65,410 | 5,729 | 76,890 | 200,749 |
| North Dakota | 642 | 16,457 | 12,127 | 718 | 6,519 | 35,821 |
| Ohio | 6,908 | 118,264 | 137,006 | 10,876 | 30,461 | 296,607 |
| Oklahoma | 2,336 | 26,940 | 36,276 | 3,160 | 45,632 | 112,008 |
| Oregon | 1,090 | 18,067 | 29,950 | 699 | 10,560 | 59,276 |
| Pennsylvania | 9,900 | 427,983 | 340,949 | 9,394 | 121,931 | 900,257 |
| Rhode Island | 713 | 5,422 | 8,917 | 341 | 1,684 | 16,364 |
| South Carolina | 1,900 | 10,946 | 22,484 | 1,600 | 25,752 | 60,782 |
| South Dakota | 643 | 13,001 | 10,301 | 660 | 18,196 | 42,158 |
| Tennessee | 2,916 | 18,833 | 50,250 | 3,428 | 89,991 | 162,502 |
| Texas | 6,415 | 80,407 | 79,040 | 3,838 | 68,240 | 231,525 |
| Utah | 550 | 13,278 | 27,733 | 546 | 2,308 | 43,865 |
| Vermont | 359 | 2,023 | 4,297 | 250 | 4,550 | 11,120 |
| Virginia [2] | 2,678 | 34,460 | 51,324 | 2,809 | 47,894 | 136,487 |
| Washington | 1,736 | 35,418 | 45,616 | 2,315 | 18,262 | 101,611 |
| West Virginia | 1,902 | 15,591 | 63,508 | 1,427 | 22,503 | 103,029 |
| Wisconsin | 3,138 | 25,942 | 38,325 | 2,988 | 54,731 | 121,986 |
| Wyoming | 251 | 6,322 | 4,801 | 303 | 3,270 | 14,696 |
| Total | 131,669 | 2,268,982 | 3,748,853 | 166,526 | 1,650,220 | 7,834,581 |
| Size of community: | | | | | | |
| 200–500 | 4,108 | 235,018 | 263,972 | 6,842 | ..... | 506,732 |
| 500–1,000 | 3,584 | 125,804 | 218,463 | 8,589 | ..... | 352,856 |
| 1,000–5,000 | 13,179 | 255,889 | 558,682 | 33,631 | ..... | 848,202 |
| 5,000–10,000 | 7,385 | 113,579 | 219,665 | 15,043 | ..... | 348,287 |
| 10,000–25,000 | 10,158 | 153,057 | 237,494 | 18,731 | ..... | 409,282 |
| 25,000–50,000 | 7,377 | 109,232 | 161,102 | 12,908 | ..... | 283,242 |
| 50,000–100,000 | 7,552 | 100,896 | 177,226 | 9,327 | ..... | 287,449 |
| Over 100,000 | 38,809 | 1,174,607 | 1,912,249 | 61,455 | ..... | 3,148,311 |

[1] Population stated in thousands and obtained from 1940 census. Data for population group 200–500 obtained from Rand McNally Commercial and Marketing Atlas, 74th Edition. Community populations include both incorporated and unincorporated communities. Where more than 1 community was served by a single water or sewerage system they were considered as a single community.

[2] Figures for Georgia and Virginia estimated on basis of costs in adjacent States because of inadequate surveys. They are included in order to obtain national totals.

## STATUS OF WORK

About 745 million dollars' worth of water and sewerage work is ready for construction. An additional 1.5 billion dollars' worth is in the planning stage. The remaining 3.75 billion dollars' worth of work is less far advanced. No breakdown by status has been made for refuse disposal facilities or for rural sanitation work. Refuse disposal facilities involve little of the construction work which re-

quires advance planning of the type necessary for water supply and sewerage work. The individual facilities needed for rural water supply and waste disposal require no advance planning either.

Figure 2 shows graphically the status of water and sewerage projects. The amounts of water and sewerage work that are ready for construction are about equal. The amount of sewerage work in the planning stage is roughly 50 percent greater than the water work. Almost twice as much sewerage work as water work is included in projects for the future.

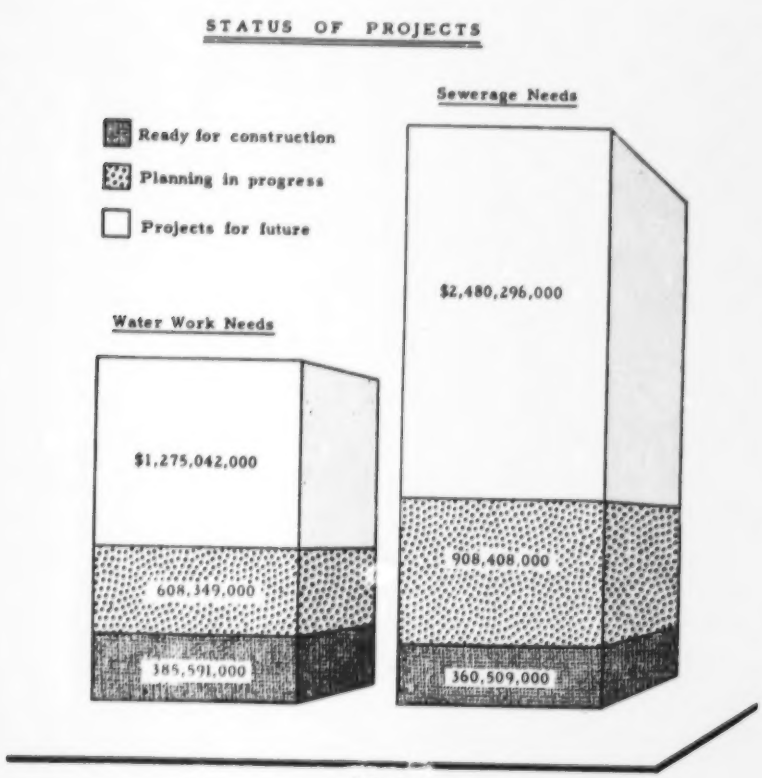



FIGURE 2

Two-thirds of the work that is ready for construction, and half of that in the planning stage, is in cities of over 100,000 population. (See table 4.) These cities include about 41 percent of the population in all communities with more than 200 people. In communities of less than 1,000, little more than 10 percent of the needs will be met

TABLE 4.—*Cost estimates for needed water works, sewerage works, and garbage and refuse disposal facilities in communities of various sizes and status of projects*

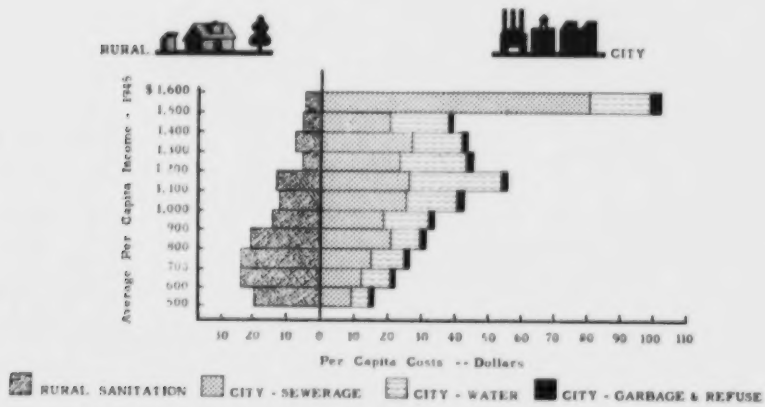
| Size of community and status of projects | Waterworks | | Sewerage works | | Garbage and refuse disposal—Cost | Total | |
|---|---|---|---|---|---|---|---|
| | Cost | Percent of total | Cost | Percent of total | | Cost | Percent of total |
| | *Thousands* | | *Thousands* | | *Thousands* | *Thousands* | |
| 200 to 500: | | | | | | | |
| Ready for Construction | $7,000 | 3.3 | $1,227 | 0.5 | ..... | $8,827 | 1.8 |
| Planning in Progress | 13,765 | 5.8 | 15,128 | 5.7 | ..... | 28,893 | 5.7 |
| Projects for Future | 214,553 | 90.9 | 247,617 | 93.8 | 6,842 | 469,012 | 92.5 |
| Total | 235,918 | 100.0 | 263,972 | 100.0 | 6,842 | 506,732 | 100.0 |
| 500 to 1,000: | | | | | | | |
| Ready for Construction | 10,294 | 8.2 | 10,291 | 4.7 | ..... | 20,585 | 5.8 |
| Planning in Progress | 18,295 | 14.5 | 34,685 | 15.9 | ..... | 52,980 | 15.1 |
| Projects for Future | 97,215 | 77.3 | 173,487 | 79.4 | 8,589 | 279,291 | 79.1 |
| Total | 125,804 | 100.0 | 218,463 | 100.0 | 8,589 | 352,856 | 100.0 |
| 1,000 to 5,000: | | | | | | | |
| Ready for Construction | 23,274 | 9.1 | 31,276 | 5.6 | ..... | 54,550 | 6.4 |
| Planning in Progress | 56,041 | 21.9 | 105,933 | 18.9 | ..... | 161,974 | 19.1 |
| Projects for Future | 176,574 | 69.0 | 421,473 | 75.5 | 33,631 | 631,678 | 74.5 |
| Total | 255,889 | 100.0 | 558,682 | 100.0 | 33,631 | 848,202 | 100.0 |
| 5,000 to 10,000: | | | | | | | |
| Ready for Construction | 15,250 | 13.4 | 22,435 | 10.2 | ..... | 37,685 | 10.8 |
| Planning in Progress | 38,051 | 33.5 | 74,125 | 33.8 | ..... | 112,176 | 32.2 |
| Projects for Future | 60,278 | 53.1 | 123,105 | 55.0 | 15,043 | 198,426 | 57.0 |
| Total | 113,579 | 100.0 | 219,665 | 100.0 | 15,043 | 348,287 | 100.0 |
| 10,000 to 25,000: | | | | | | | |
| Ready for Construction | 26,302 | 17.2 | 31,388 | 13.2 | ..... | 57,780 | 14.1 |
| Planning in Progress | 51,622 | 33.8 | 88,789 | 37.4 | ..... | 140,411 | 34.3 |
| Projects for Future | 75,043 | 49.0 | 117,317 | 49.4 | 18,731 | 211,091 | 51.6 |
| Total | 153,057 | 100.0 | 237,494 | 100.0 | 18,731 | 409,282 | 100.0 |
| 25,000 to 50,000: | | | | | | | |
| Ready for Construction | 12,975 | 11.9 | 19,861 | 12.3 | ..... | 32,834 | 11.6 |
| Planning in Progress | 41,685 | 38.1 | 58,404 | 36.2 | ..... | 100,089 | 35.4 |
| Projects for Future | 54,574 | 50.0 | 82,837 | 51.5 | 12,908 | 150,319 | 53.0 |
| Total | 109,232 | 100.0 | 161,102 | 100.0 | 12,908 | 283,242 | 100.0 |
| 50,000 to 100,000: | | | | | | | |
| Ready for Construction | 6,854 | 6.8 | 6,244 | 3.5 | ..... | 13,098 | 4.6 |
| Planning in Progress | 52,401 | 52.0 | 92,958 | 52.5 | ..... | 145,359 | 50.7 |
| Projects for Future | 41,641 | 41.2 | 78,024 | 44.0 | 9,327 | 128,992 | 44.7 |
| Total | 100,896 | 100.0 | 177,226 | 100.0 | 9,327 | 287,449 | 100.0 |
| Over 100,000: | | | | | | | |
| Ready for Construction | 282,954 | 24.0 | 237,787 | 12.4 | ..... | 520,741 | 16.5 |
| Planning in Progress | 336,489 | 28.7 | 438,026 | 22.9 | ..... | 774,515 | 24.6 |
| Projects for Future | 555,164 | 47.3 | 1,236,436 | 64.7 | 61,455 | 1,853,055 | 58.9 |
| Total | 1,174,607 | 100.0 | 1,912,249 | 100.0 | 61,455 | 3,148,311 | 100.0 |
| Total: | | | | | | | |
| Ready for Construction | 385,591 | 17.0 | 360,509 | 9.6 | ..... | 746,100 | 12.1 |
| Planning in Progress | 608,349 | 26.8 | 908,048 | 24.2 | ..... | 1,516,397 | 24.5 |
| Projects for Future | 1,275,042 | 56.2 | 2,480,296 | 66.2 | 166,526 | 3,921,864 | 63.4 |
| Total | 2,268,982 | 100.0 | 3,748,853 | 100.0 | 166,526 | 6,184,361 | 100.0 |

by projects now ready for construction or in the planning stage, as compared with more than 40 percent in the largest cities. Since the surveys were completed, a considerable amount of additional planning work has been done. The figures as shown in tables 5 and 8 do not reflect this. The over-all change will probably not be appreciable, but in certain States the errors may be important.

## PER CAPITA COSTS

The per capita cost of needs in the various States ranges from about $23 in Rhode Island to $107 in New York, and averages about $60 for the Nation as a whole (based on 1940 populations). Figure 3 shows per capita costs of sanitation needs as related to income level. In general, rural sanitation needs are less in the more prosperous States than in those with lower incomes. Urban needs tend to increase as the income level rises. Figure 4 shows the per capita cost

SANITATION NEEDS BY INCOME LEVEL




* Data on income from U.S. Department of Commerce.
Per capita costs based on total cost for all states within the same per capita income range.

FIGURE 3

SANITATION NEEDS BY REGION

Per Capita Costs -- Dollars

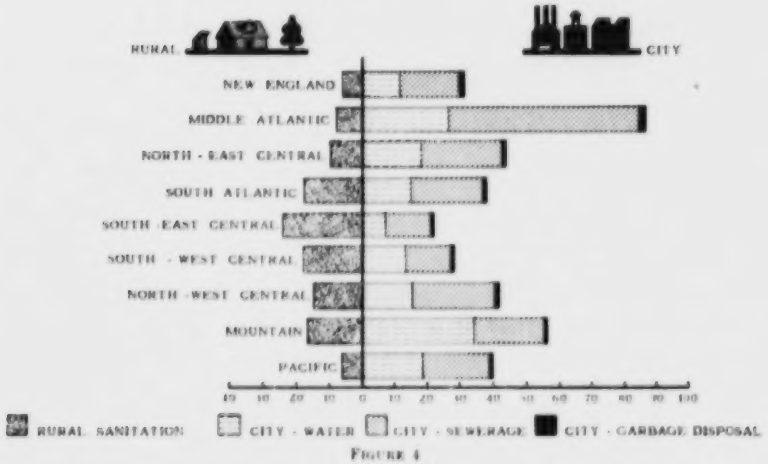



FIGURE 4

of needs for various regions. The Middle Atlantic States need the greatest amount of work. Rural needs are greatest in the Southern States.

Figure 5 shows the per capita cost of water and sewerage needs in communities of various sizes. The highest per capita costs are in the smallest communities. These costs decrease as the community increases in size up to communities of 100,000 population. In these large cities, costs are much higher than in cities of intermediate size. To some extent the high cost of the needs of the smallest communities is due to the fact that fewer of them have public waterworks and sewerage systems, whereas the larger communities ordinarily do have such facilities. In the large cities the high per capita cost is due mainly to the tremendous expense of needed work in such metropolitan areas as New York, Chicago, Philadelphia, Detroit, St. Louis, Pittsburgh and Denver.

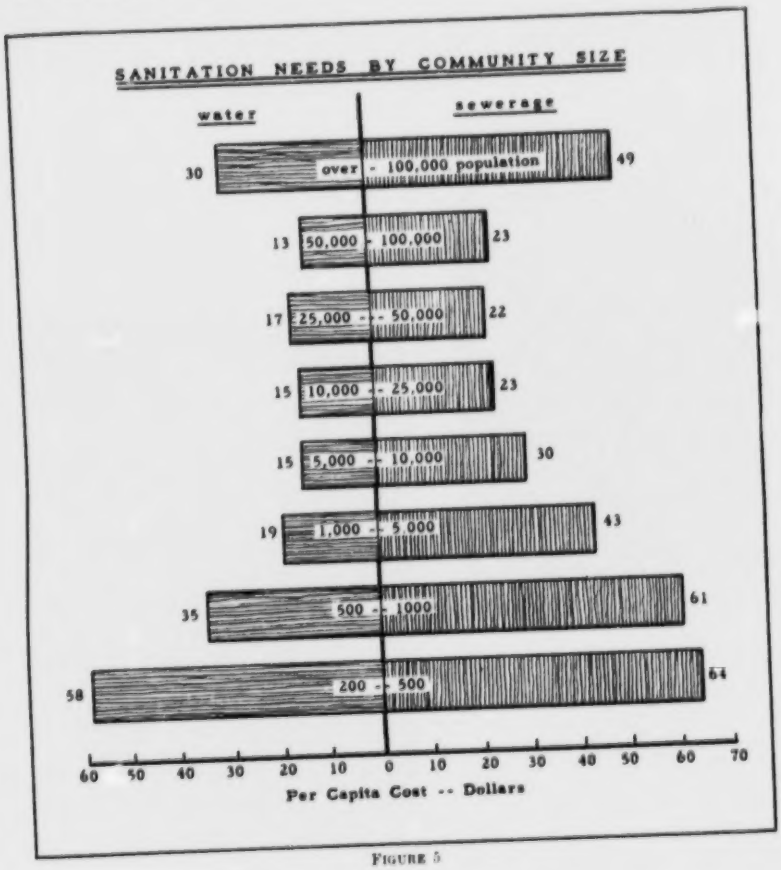



FIGURE 5

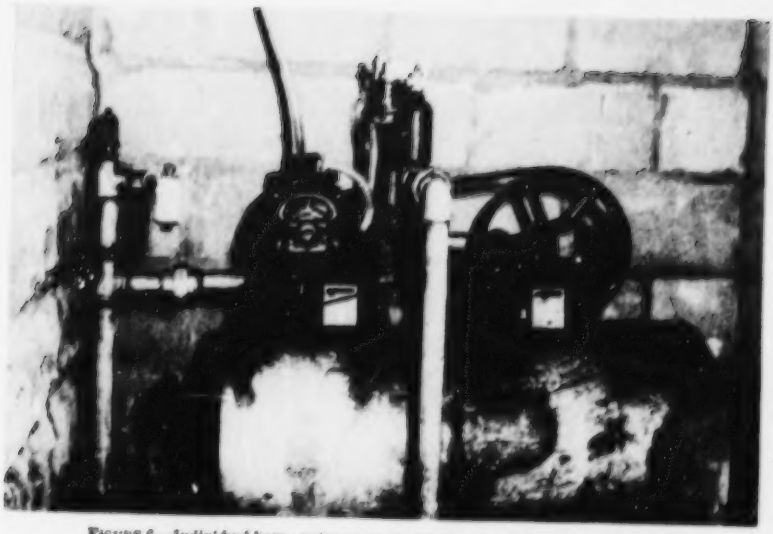


FIGURE 6.—Individual home water-pressure system using well as source of supply.

FIGURE 7.—Typical outdoor well water supply utilized in rural areas.

FIGURE 8.—Turbine pump installation on community ground water supply.

FIGURE 9.—Elevated water storage tank for small community water supply.

FIGURE 10.—Construction of water-supply pipe line, Williamsburg, Va.

FIGURE 11.—Modern Water Purification Plant, Washington Suburban Sanitary District, Montgomery County, Md.

## WATERWORKS

About one-third of the total of over 2.2 billion dollars needed for waterworks is for the development of water supply sources. (See table 5.) This cost reflects the high cost of completing New York City's Delaware watershed supply; development of an upland supply to replace Philadelphia's present highly polluted water supply sources, and additional developments to augment Denver's existing sources of supply. About half of the total cost of waterworks needs is for distribution systems, including pumping stations and storage. Approximately one-sixth of the total cost is for treatment works, of which the largest single item is to furnish Chicago with filtered water. About two-thirds of Chicago's water is not filtered now.

Complete waterwork systems are needed in about 5,700 communities with a combined population of 2,360,000. (See table 6.) Most of these communities have less than 1,000 population. But 159 towns, with from 1,000 to 5,000 people, and 3 towns of over 5,000, need complete water systems.

Improvements or extensions of existing water systems are needed at 14,800 cities and towns with a population of more than 79,000,000. About 2 billion dollars will be required for this work. Almost 6,500 communities with over 10 million population were found to have no needs for waterwork systems. This was either because their present ones were adequate or because it was considered that community systems were impracticable and that the people should continue to rely upon individual water supplies.

Over 9,000 wells and well pumps; 3,200 new treatment plants, and additions or improvements to 4,700 existing plants; 8,200 elevated and ground storage tanks on distribution systems (with a total capacity of about 2 billion gallons) and more than 45,000 miles of water pipe of various sizes are needed (table 7).

## SEWERAGE

Table 8 shows costs of the various elements of the sewerage needs by States. The needs of our larger cities swell the total cost. California, Illinois, Michigan, Missouri, New Jersey, New York, Ohio, and Pennsylvania all need more than 100 million dollars' worth of sewerage work. New York State alone requires over a billion dollars, almost 30 percent of the national total. Treatment works will cost about one-third of the total of 3.7 billion dollars, and collecting and intercepting sewers most of the remaining two-thirds. The needs include more than 80,000 miles of sewers, over 12,000 new sewage treatment plants, and additions to some 1,000 existing treatment plants (table 9). Most of these plants will serve small communities,

but more than a third of the total cost of the treatment works will be needed in cities of over 100,000. At present all or most of the sewage from New York, Philadelphia, Pittsburgh, Boston, Los Angeles, Cincinnati, Louisville, San Francisco, St. Louis, and many other large cities, is discharged without treatment.

More than 9,100 communities need complete sewerage systems. Most of these are towns of less than 1,000 people. Yet there are 81 towns, with more than 5,000 population, which now lack sewers, including 2 towns of over 25,000 people. The cost of these new systems will be 654 million dollars, approximately $103 per capita for the 6,360,000 people to be served (table 10). Necessary improvements and extensions to more than 9,900 existing sewerage systems in communities with 79 million people will cost about 3.1 billion dollars.

### REFUSE DISPOSAL

More than 12,000 refuse collection trucks are needed. These will cost about 49 million dollars (table 11). About 71 million dollars will be required to build the 1,090 incinerators necessary for disposing of these municipal wastes. Equipment, such as bulldozers and draglines, for the 5,500 sanitary land-fill projects needed, will cost about 25 million dollars. Land and miscellaneous expenses will take an additional 21 million. As these figures indicate, comparatively small amounts of money will do a large amount of good.

### RURAL SANITATION

Almost 6,400,000 rural homes need either repairs to their water supplies or completely new supplies which will cost about 870 million dollars (table 12). New privies or repairs to existing ones are needed at more than 6,100,000 homes without modern plumbing. These will cost almost 400 million dollars. Approximately 1,700,000 rural homes which have, or are planning to install, modern plumbing need septic tanks for disposal of household sewage. The cost of this work will be about 380 million dollars.

### MATERIAL AND LABOR REQUIREMENTS

Table 13 shows the cost of various types of materials which would be required to provide the needed water and sewerage works for communities and the cost of the necessary labor on the site of the construction work. It is estimated that this would require more than 1½ billion man-hours of on-site labor. An additional 2 billion man-hours of work would be created in mines, forests, factories, and transportation industries. This amounts to a year's work for more than 1,750,000 people.

TABLE 5.—*Water works needs—Estimated cost of various elements and status of projects, by States and size of community (costs in thousands of dollars)*

| State | Source of supply, cost | Treatment cost | Distribution system cost | Miscellaneous cost | Ready for construction | | Planning in progress | | Projects for future | | Total cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cost | Percent | Cost | Percent | Cost | Percent | |
| Alabama | $2,813 | $2,910 | $10,041 | $718 | $2,696 | 16.4 | $6,420 | 38.9 | $7,366 | 44.7 | $16,482 |
| Arizona | 573 | 150 | 1,923 | 5,027 | 566 | 7.7 | 1,050 | 13.7 | 6,029 | 78.6 | 7,675 |
| Arkansas | 2,527 | 3,340 | 15,766 | 67 | 736 | 3.4 | 2,269 | 10.5 | 18,591 | 86.1 | 21,596 |
| California | 4,180 | 11,728 | 101,583 | 3,472 | 9,732 | 8.1 | 60,040 | 49.6 | 51,171 | 42.3 | 120,963 |
| Colorado | 68,684 | 5,174 | 10,900 | 331 | 2,268 | 2.7 | 74,225 | 87.0 | 8,686 | 10.3 | 85,179 |
| Connecticut | 10,647 | 2,285 | 7,005 | 213 | 8,377 | 41.6 | 6,616 | 32.9 | 5,127 | 25.5 | 20,120 |
| Delaware | 40 | 462 | 1,547 | 12 | 378 | 18.4 | 1,541 | 75.3 | 172 | 8.3 | 2,061 |
| District of Columbia | 2,713 | 8,088 | 27,092 | 3,534 | 626 | 1.5 | 11,185 | 27.0 | 29,616 | 71.5 | 41,427 |
| Florida | 1,864 | 9,458 | 24,265 | 2,417 | 3,066 | 9.6 | 14,712 | 38.7 | 19,626 | 51.6 | 38,004 |
| Georgia [1] | 2,914 | 4,075 | 14,122 | 960 | 3,209 | 14.5 | 8,534 | 38.6 | 10,328 | 46.9 | 22,071 |
| Idaho | 448 | 719 | 7,791 | 35 | 487 | 5.4 | 1,019 | 11.3 | 7,487 | 83.3 | 8,993 |
| Illinois | 3,091 | 75,748 | 57,574 | 1,846 | 9,234 | 6.7 | 75,251 | 54.5 | 53,774 | 38.8 | 138,259 |
| Indiana | 2,307 | 15,644 | 25,296 | 311 | 3,847 | 8.9 | 4,825 | 11.1 | 34,786 | 80.0 | 43,458 |
| Iowa | 3,395 | 10,709 | 18,268 | 716 | 4,162 | 12.7 | 4,931 | 15.1 | 23,595 | 72.2 | 32,688 |
| Kansas | 1,859 | 3,919 | 15,335 | 98 | 1,135 | 5.4 | 7,684 | 36.2 | 12,402 | 58.4 | 21,221 |
| Kentucky | 2,705 | 4,617 | 14,542 | 187 | 570 | 2.6 | 3,656 | 16.6 | 17,825 | 80.8 | 22,051 |
| Louisiana | 1,138 | 6,129 | 24,263 | 1,182 | 4,957 | 15.2 | 1,887 | 5.8 | 25,872 | 79.0 | 32,712 |
| Maine | 651 | 306 | 5,220 | 46 | 359 | 5.7 | 171 | 2.7 | 5,783 | 91.6 | 6,313 |
| Maryland | 26,317 | 4,863 | 14,149 | 136 | 1,373 | 3.0 | 35,830 | 78.8 | 8,262 | 18.2 | 45,465 |
| Massachusetts | 7,473 | 5,717 | 39,421 | 1,478 | 8,697 | 16.1 | 16,635 | 30.7 | 28,757 | 53.2 | 54,089 |
| Michigan | 2,752 | 11,272 | 119,130 | 1,688 | 32,762 | 24.3 | 43,114 | 31.9 | 58,906 | 43.8 | 134,842 |
| Minnesota | 4,174 | 5,194 | 36,300 | 77 | 3,209 | 7.0 | 6,838 | 14.9 | 35,758 | 78.1 | 45,805 |
| Mississippi | 621 | 1,286 | 8,702 | 257 | 1,137 | 10.0 | 4,507 | 39.6 | 5,722 | 50.4 | 11,366 |
| Missouri | 5,062 | 9,626 | 33,595 | 3,939 | 1,086 | 2.1 | 11,674 | 22.3 | 39,372 | 75.6 | 52,132 |
| Montana | 628 | 1,337 | 6,830 | 1 | 609 | 7.1 | 2,166 | 25.1 | 5,821 | 67.8 | 8,596 |
| Nebraska | 2,253 | 4,631 | 12,042 | 336 | 824 | 4.3 | 11,781 | 61.2 | 6,647 | 34.5 | 19,252 |
| Nevada | 210 | 64 | 1,360 | 7 | 262 | 15.6 | 192 | 10.3 | 1,384 | 74.1 | 1,868 |
| New Hampshire | 656 | 1,894 | 3,779 | 15 | 0 | .0 | 0 | .0 | 6,344 | 100.0 | 6,344 |
| New Jersey | 5,766 | 3,741 | 20,846 | 2,729 | 3,461 | 12.4 | 4,556 | 11.5 | 25,187 | 76.1 | 33,084 |
| New Mexico | 842 | 289 | 4,133 | 226 | 278 | 5.1 | 724 | 13.2 | 4,486 | 81.7 | 5,490 |
| New York | 163,343 | 18,215 | 64,922 | 822 | 162,813 | 65.8 | 17,635 | 7.1 | 66,934 | 27.1 | 247,182 |
| North Carolina | 10,273 | 11,417 | 30,400 | 531 | 5,493 | 10.5 | 15,085 | 28.6 | 32,142 | 60.9 | 52,720 |
| North Dakota | 1,467 | 2,613 | 12,353 | 24 | 1,209 | 7.3 | 4,157 | 25.4 | 11,091 | 67.3 | 16,457 |
| Ohio | 12,963 | 68,450 | 54,862 | 1,980 | 41,315 | 34.8 | 27,209 | 23.1 | 49,680 | 42.1 | 118,204 |
| Oklahoma | 3,709 | 4,730 | 18,202 | 260 | 3,223 | 12.0 | 7,956 | 29.5 | 15,761 | 58.5 | 26,940 |
| Oregon | 985 | 1,361 | 15,637 | 84 | 4,171 | 23.1 | 7,398 | 41.0 | 6,498 | 35.9 | 18,067 |
| Pennsylvania | 357,851 | 20,354 | 49,645 | 133 | 17,708 | 4.1 | 24,048 | 5.6 | 386,227 | 90.3 | 427,983 |
| Rhode Island | 6 | 2,942 | 1,541 | 1,033 | 1,879 | 34.7 | 0 | .0 | 3,543 | 65.3 | 5,422 |
| South Carolina | 1,503 | 2,786 | 6,579 | 288 | 2,746 | 25.1 | 3,229 | 29.5 | 4,971 | 45.4 | 10,946 |
| South Dakota | 1,405 | 4,602 | 6,863 | 11 | 402 | 3.1 | 1,723 | 13.2 | 10,876 | 83.7 | 13,001 |
| Tennessee | 1,252 | 2,254 | 13,908 | 1,379 | 1,483 | 7.9 | 6,857 | 36.2 | 10,513 | 55.9 | 18,853 |
| Texas | 18,109 | 11,651 | 47,451 | 5,196 | 17,908 | 22.4 | 22,970 | 28.6 | 39,439 | 49.0 | 80,407 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Utah | 741 | 1,474 | 10,972 | 91 | 4,320 | 32.5 | 3,190 | 24.0 | 5,768 | 43.5 | 13,278 |
| Vermont | 421 | 864 | 708 | 30 | 29 | 1.4 | 4 | 0.2 | 1,990 | 98.4 | 2,023 |
| Virginia [1] | 12,270 | 5,332 | 16,380 | 472 | 2,326 | 6.8 | 17,235 | 50.0 | 14,889 | 43.2 | 34,460 |
| Washington | 3,922 | 1,987 | 28,208 | 1,301 | 2,530 | 7.2 | 13,900 | 39.5 | 18,889 | 53.3 | 35,418 |
| West Virginia | 1,601 | 2,531 | 10,441 | 1,018 | 1,059 | 6.8 | 2,731 | 17.4 | 11,801 | 73.8 | 15,591 |
| Wisconsin | 1,997 | 3,371 | 19,999 | 695 | 2,571 | 9.9 | 8,204 | 31.6 | 15,167 | 58.5 | 25,942 |
| Wyoming | 686 | 1,365 | 4,298 | 3 | 1,514 | 23.9 | 1,909 | 15.8 | 3,799 | 60.3 | 6,322 |
| Total | 763,003 | 363,771 | 1,096,638 | 45,570 | 385,591 | 17.0 | 608,349 | 26.8 | 1,275,042 | 56.2 | 2,268,982 |
| Size of community: | | | | | | | | | | | |
| 200–500 | 31,477 | 14,616 | 183,923 | 5,902 | 7,766 | 3.3 | 13,569 | 5.8 | 214,553 | 90.9 | 235,918 |
| 500–1,000 | 13,177 | 16,949 | 92,887 | 2,781 | 10,306 | 8.2 | 18,283 | 14.5 | 97,215 | 77.3 | 125,8045 |
| 1,000–5,000 | 19,317 | 32,216 | 180,513 | 3,843 | 23,420 | 9.1 | 55,993 | 21.9 | 176,574 | 69.0 | 255,889 |
| 5,000–10,000 | 10,145 | 32,812 | 68,983 | 1,637 | 15,335 | 13.5 | 37,990 | 33.4 | 60,278 | 53.1 | 113,579 |
| 10,000–25,000 | 14,563 | 30,722 | 99,760 | 2,006 | 26,492 | 17.3 | 51,522 | 33.7 | 75,043 | 49.0 | 153,057 |
| 25,000–50,000 | 13,286 | 26,021 | 95,767 | 3,158 | 12,973 | 11.9 | 41,685 | 38.1 | 54,574 | 50.0 | 109,232 |
| 50,000–100,000 | 16,097 | 20,114 | 56,852 | 7,233 | 6,854 | 6.8 | 52,401 | 52.0 | 41,641 | 41.2 | 100,896 |
| Over 100,000 | 644,341 | 164,311 | 346,945 | 19,010 | 282,954 | 24.0 | 336,489 | 28.7 | 555,164 | 47.3 | 1,174,607 |

[1] Figures for Georgia and Virginia estimated on basis of costs in adjacent States because of inadequate surveys. They are included in order to obtain national totals.

TABLE 6.—*Water works needs—Number and population of communities with and without needs including cost of new systems and improvements to existing systems, by States and size of community*

| State | New systems | | | | Improvements to existing systems | | | | No needs reported | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of communities | Population [1] | Cost | Cost per capita | Number of communities | Population [1] | Cost | Cost per capita | Number of communities | Population [1] | Number of communities | Population [1] | Cost | Cost per capita |
| | | *Thousands* | *Thousands* | | | *Thousands* | *Thousands* | | | *Thousands* | | *Thousands* | *Thousands* | |
| Alabama | 265 | 76 | $4,878 | $65 | 184 | 921 | $11,604 | $13 | 245 | 188 | 634 | 1,185 | $16,482 | $14 |
| Arizona | 8 | 3 | 196 | 65 | 128 | 259 | 7,479 | 28 | 28 | 17 | 164 | 279 | 7,675 | 28 |
| Arkansas | 327 | 121 | 12,889 | 106 | 170 | 568 | 8,797 | 15 | | | 497 | 689 | 21,686 | 31 |
| California | 35 | 15 | 1,220 | 81 | 796 | 5,811 | 119,743 | 21 | 84 | 30 | 915 | 5,856 | 120,963 | 21 |
| Colorado | 4 | 3 | 331 | 110 | 295 | 750 | 84,848 | 113 | 7 | 15 | 306 | 768 | 85,179 | 111 |
| Connecticut | | | | | 65 | 1,337 | 20,120 | 15 | 102 | 298 | 167 | 1,635 | 20,120 | 12 |
| Delaware | 1 | 1 | 42 | 42 | 53 | 184 | 2,019 | 11 | 24 | 6 | 78 | 191 | 2,061 | 11 |
| District of Columbia | | | | | 1 | 663 | 41,427 | 63 | | | 1 | 663 | 41,427 | 63 |
| Florida | 57 | 39 | 2,894 | 74 | 366 | 1,201 | 35,110 | 29 | 105 | 58 | 528 | 1,298 | 38,004 | 29 |
| Georgia [2] | 169 | 72 | 4,935 | 68 | 262 | 1,205 | 17,136 | 14 | 278 | 221 | 709 | 1,498 | 22,071 | 15 |
| Idaho | 23 | 8 | 718 | 90 | 183 | 270 | 8,275 | 31 | 10 | 3 | 216 | 281 | 8,993 | 32 |
| Illinois | 360 | 164 | 29,151 | 177 | 827 | 6,269 | 109,108 | 17 | 49 | 110 | 1,236 | 6,543 | 138,259 | 21 |
| Indiana | 239 | 95 | 10,337 | 108 | 499 | 2,245 | 33,121 | 15 | 31 | 11 | 769 | 2,351 | 43,458 | 18 |
| Iowa | 162 | 63 | 5,973 | 95 | 643 | 1,484 | 26,715 | 18 | | | 805 | 1,547 | 32,688 | 21 |
| Kansas | 149 | 53 | 7,605 | 143 | 430 | 1,007 | 13,616 | 14 | 4 | 3 | 583 | 1,063 | 21,221 | 20 |
| Kentucky | 288 | 99 | 8,684 | 88 | 358 | 1,024 | 13,367 | 13 | 82 | 151 | 728 | 1,274 | 22,051 | 17 |
| Louisiana | 194 | 87 | 5,159 | 77 | 191 | 1,118 | 27,553 | 25 | 122 | 97 | 507 | 1,282 | 32,712 | 25 |
| Maine | 38 | 37 | 2,490 | 67 | 323 | 639 | 3,823 | 6 | 49 | 153 | 410 | 829 | 6,313 | 8 |
| Maryland | 110 | 42 | 2,496 | 59 | 119 | 1,286 | 42,989 | 33 | 111 | 75 | 340 | 1,403 | 45,485 | 32 |
| Massachusetts | 25 | 31 | 3,440 | 111 | 187 | 3,607 | 50,649 | 14 | 131 | 678 | 343 | 4,316 | 54,089 | 13 |
| Michigan | 134 | 55 | 6,309 | 114 | 366 | 3,686 | 128,533 | 35 | 285 | 203 | 795 | 3,954 | 134,842 | 34 |
| Minnesota | 217 | 76 | 17,938 | 236 | 420 | 1,637 | 27,867 | 17 | 44 | 69 | 681 | 1,782 | 45,805 | 26 |
| Mississippi | 83 | 42 | 2,865 | 68 | 209 | 574 | 8,501 | 15 | 150 | 41 | 442 | 657 | 11,366 | 17 |
| Missouri | 381 | 136 | 16,305 | 120 | 349 | 2,303 | 35,827 | 16 | 14 | 12 | 744 | 2,451 | 52,132 | 21 |
| Montana | 37 | 12 | 1,754 | 146 | 155 | 301 | 6,842 | 23 | 9 | 5 | 201 | 318 | 8,596 | 27 |
| Nebraska | 11 | 3 | 585 | 195 | 415 | 770 | 18,667 | 24 | | | 426 | 773 | 19,252 | 25 |
| Nevada | 4 | 2 | 308 | 154 | 45 | 68 | 1,560 | 23 | 12 | 13 | 61 | 83 | 1,868 | 22 |
| New Hampshire | 42 | 41 | 3,638 | 89 | 47 | 203 | 2,706 | 13 | 121 | 237 | 210 | 481 | 6,344 | 13 |
| New Jersey | 6 | 7 | 930 | 133 | 413 | 2,327 | 32,154 | 14 | 197 | 1,574 | 616 | 3,908 | 33,084 | 8 |
| New Mexico | 113 | 48 | 2,782 | 58 | 66 | 198 | 2,708 | 14 | 40 | 38 | 219 | 284 | 5,490 | 19 |
| New York | 240 | 90 | 16,185 | 180 | 913 | 11,394 | 230,997 | 20 | 239 | 591 | 1,392 | 12,075 | 247,182 | 21 |
| North Carolina | 252 | 92 | 11,230 | 122 | 279 | 1,128 | 41,480 | 37 | 293 | 313 | 824 | 1,533 | 52,720 | 34 |
| North Dakota | 105 | 63 | 7,898 | 125 | 120 | 215 | 8,559 | 40 | | | 286 | 278 | 16,457 | 59 |
| Ohio | 436 | 173 | 18,295 | 106 | 392 | 5,010 | 99,969 | 20 | 220 | 105 | 1,248 | 5,278 | 118,264 | 22 |
| Oklahoma | 137 | 45 | 3,944 | 88 | 419 | 1,141 | 22,996 | 20 | | | 556 | 1,186 | 26,940 | 23 |
| Oregon | | | | | 286 | 645 | 18,067 | 28 | 25 | 38 | 291 | 683 | 18,067 | 26 |
| Pennsylvania | 102 | 62 | 4,804 | 77 | 343 | 4,262 | 423,179 | 99 | 1,760 | 3,796 | 2,205 | 8,120 | 427,983 | 53 |
| Rhode Island | | | | | 6 | 384 | 5,422 | 14 | 33 | 329 | 39 | 713 | 5,422 | 8 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South Carolina | 50 | 26 | 2,246 | 86 | 200 | 655 | 8,700 | 13 | 155 | 105 | 405 | 786 | 10,946 | 14 |
| South Dakota | 59 | 20 | 2,678 | 133 | 196 | 279 | 10,323 | 37 | | | 255 | 299 | 13,001 | 43 |
| Tennessee | 164 | 68 | 4,638 | 68 | 148 | 1,078 | 14,195 | 13 | 245 | 165 | 557 | 1,311 | 18,833 | 14 |
| Texas | 156 | 66 | 8,510 | 129 | 954 | 3,458 | 71,897 | 21 | 315 | 207 | 1,427 | 3,731 | 80,407 | 22 |
| Utah | 4 | 8 | 766 | 96 | 261 | 451 | 12,512 | 28 | 6 | 2 | 271 | 461 | 13,278 | 29 |
| Vermont | | | | | 67 | 201 | 2,023 | 10 | 158 | 163 | 225 | 364 | 2,023 | 6 |
| Virginia [2] | 152 | 56 | 5,370 | 96 | 228 | 994 | 29,090 | 29 | 248 | 200 | 628 | 1,250 | 34,460 | 28 |
| Washington | 9 | 2 | 437 | 219 | 412 | 1,135 | 34,981 | 31 | 36 | 25 | 457 | 1,162 | 35,418 | 30 |
| West Virginia | 136 | 75 | 5,320 | 71 | 434 | 710 | 10,271 | 14 | 326 | 299 | 896 | 1,084 | 15,591 | 14 |
| Wisconsin | 210 | 98 | 8,120 | 83 | 394 | 1,875 | 17,822 | 10 | 57 | 68 | 661 | 2,041 | 25,942 | 13 |
| Wyoming | 13 | 5 | 729 | 146 | 64 | 142 | 5,593 | 39 | 20 | 8 | 97 | 155 | 6,322 | 41 |
| Total | 5,710 | 2,360 | 258,032 | 109 | 14,861 | 79,072 | 2,010,950 | 25 | 6,480 | 10,720 | 27,051 | 92,152 | 2,268,982 | 25 |
| Size of community: | | | | | | | | | | | | | | |
| 200–500 | 4,553 | 1,429 | 171,333 | 121 | 5,067 | 1,538 | 64,585 | 41 | 4,003 | 1,141 | 13,623 | 4,108 | 235,918 | 58 |
| 500–1,000 | 995 | 672 | 61,478 | 92 | 3,107 | 2,252 | 64,326 | 29 | 905 | 660 | 5,007 | 3,584 | 125,804 | 35 |
| 1,000–5,000 | 159 | 241 | 24,163 | 100 | 4,929 | 10,276 | 231,726 | 23 | 1,184 | 2,662 | 6,272 | 13,179 | 255,889 | 19 |
| 5,000–10,000 | 3 | 18 | 1,058 | 59 | 851 | 5,922 | 112,521 | 19 | 208 | 1,445 | 1,062 | 7,385 | 113,579 | 15 |
| 10,000–25,000 | | | | | 545 | 8,227 | 153,057 | 19 | 128 | 1,931 | 673 | 10,158 | 153,057 | 19 |
| 25,000–50,000 | | | | | 183 | 6,378 | 109,232 | 17 | 29 | 999 | 212 | 7,377 | 109,232 | 17 |
| 50,000–100,000 | | | | | 93 | 6,382 | 100,896 | 16 | 17 | 1,170 | 110 | 7,552 | 100,896 | 13 |
| Over 100,000 | | | | | 86 | 38,097 | 1,174,607 | 31 | 6 | 712 | 92 | 38,809 | 1,174,607 | 30 |

[1] Populations obtained from 1940 census. Community populations include both incorporated and unincorporated communities. Where more than one community was served by a single water or sewerage system they were considered as a single community.

[2] Figures for Georgia and Virginia estimated on basis of costs in adjacent States because of inadequate survey. They are included in order to obtain national totals.

TABLE 7.—*Water works needs—quantities of various elements, by States*

| State | Number of wells | Number of well pumps | Number of treatment plants | | Distribution system storage | | | | Mains (length in thousands of feet) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Elevated | | Ground | | | | | | | |
| | | | New | Additions | Number | Total capacity (million gallons) | Number | Total capacity (million gallons) | 4-inch and smaller diameter | 6-inch diameter | 8-inch diameter | 10-inch diameter | 12-inch diameter | Over 12-inch diameter |
| Alabama | 161 | 144 | 82 | 202 | 173 | 11.9 | 33 | 5.0 | 2,075 | 1,124 | 231 | 101 | 107 | 159 |
| Arizona | 37 | 38 | 2 | 31 | 2 | 0.4 | 5 | 2.1 | 288 | 93 | 71 | 63 | 126 | 20 |
| Arkansas | 328 | 332 | 95 | 48 | 437 | 28.9 | 43 | 11.6 | 4,493 | 1,487 | 191 | 24 | 72 | 43 |
| California | 175 | 172 | 47 | 40 | 89 | 20.3 | 77 | 303.8 | 3,113 | 3,037 | 1,324 | 445 | 792 | 2,190 |
| Colorado | 60 | 81 | 14 | 90 | 39 | 5.4 | 22 | 25.8 | 602 | 675 | 600 | 197 | 152 | 449 |
| Connecticut | 50 | 51 | 15 | 2 | 10 | 11.4 | 0 | 0.0 | 4 | 343 | 369 | 124 | 126 | 136 |
| Delaware | 3 | 7 | 4 | 1 | 4 | 0.3 | 0 | 0.0 | 30 | 36 | 23 | 15 | 33 | 25 |
| District of Columbia [1] | | | | | | | | | | | | | | |
| Florida | 219 | 266 | 26 | 246 | 167 | 29.6 | 36 | 8.2 | 1,714 | 2,176 | 460 | 68 | 106 | 540 |
| Georgia [1] | | | | | | | | | | | | | | |
| Idaho | 73 | 105 | 9 | 60 | 69 | 7.6 | 33 | 6.4 | 912 | 881 | 368 | 149 | 85 | 111 |
| Illinois | 393 | 379 | 428 | 157 | 419 | 41.5 | 40 | 38.2 | 5,972 | 6,703 | 2,424 | 310 | 557 | 471 |
| Indiana | 158 | 147 | 205 | 272 | 289 | 45.8 | 28 | 9.6 | 2,499 | 3,148 | 581 | 110 | 343 | 90 |
| Iowa | 665 | 659 | 430 | 34 | 108 | 12.8 | 14 | 12.0 | 4,786 | 1,160 | 196 | 19 | 38 | 74 |
| Kansas | 303 | 470 | 47 | 342 | 186 | 14.6 | 5 | 4.9 | 2,419 | 1,214 | 515 | 71 | 225 | 52 |
| Kentucky | 291 | 313 | 146 | 268 | 98 | 9.6 | 249 | 16.4 | 1,532 | 2,097 | 224 | 36 | 50 | 202 |
| Louisiana | 218 | 220 | 54 | 381 | 285 | 25.6 | 11 | 18.1 | 2,296 | 2,207 | 272 | 48 | 288 | 249 |
| Maine | 19 | 19 | 5 | 1 | 50 | 1.8 | 2 | 0.1 | 252 | 255 | 104 | 26 | 186 | 82 |
| Maryland | 101 | 101 | 102 | 0 | 99 | 15.2 | 6 | 64.6 | 7 | 918 | 318 | 139 | 206 | 209 |
| Massachusetts | 75 | 33 | 41 | 4 | 50 | 22.4 | 9 | 39.0 | 140 | 1,627 | 2,265 | 718 | 825 | 428 |
| Michigan | 260 | 258 | 57 | 47 | 174 | 32.9 | 16 | 17.6 | 1,657 | 3,492 | 6,556 | 191 | 1,976 | 1,726 |
| Minnesota | 452 | 605 | 96 | 75 | 290 | 20.8 | 12 | 86.8 | 1,022 | 4,842 | 1,132 | 95 | 54 | 208 |
| Mississippi | 98 | 98 | 14 | 211 | 143 | 19.0 | 8 | 1.1 | 1,365 | 1,142 | 148 | 50 | 38 | 57 |
| Missouri | 385 | 423 | 164 | 74 | 408 | 24.0 | 33 | 136.5 | 4,580 | 2,167 | 842 | 299 | 484 | 576 |
| Montana | 65 | 84 | 11 | 25 | 31 | 2.9 | 49 | 26.2 | 462 | 786 | 231 | 207 | 116 | 66 |
| Nebraska | 245 | 445 | 68 | 370 | 59 | 9.4 | 17 | 30.4 | 1,232 | 424 | 109 | 187 | 121 | 223 |
| Nevada | 26 | 28 | 1 | 32 | 6 | 0.7 | 15 | 1.8 | 312 | 132 | 49 | | 5 | 20 |
| New Hampshire | 30 | 30 | 11 | 3 | 35 | 2.2 | | | 0 | 229 | 395 | 34 | 14 | |
| New Jersey | 84 | 77 | 18 | 6 | 29 | 7.8 | 19 | 31.9 | 0 | 540 | 1,112 | 169 | 316 | 298 |
| New Mexico | 200 | 203 | 7 | 28 | 58 | 2.2 | 44 | 10.3 | 1,096 | 526 | 147 | 39 | 25 | 18 |
| New York | 348 | 355 | 127 | 263 | 348 | 76.1 | 69 | 54.6 | 724 | 5,517 | 2,626 | 211 | 606 | 804 |
| North Carolina | 331 | 344 | 77 | 31 | 284 | 33.6 | 28 | 26.9 | 2,491 | 3,832 | 771 | 161 | 174 | 515 |
| North Dakota | 253 | 268 | 26 | 82 | 187 | 12.3 | 19 | 3.4 | 2,203 | 4,735 | 1,222 | 293 | 304 | 313 |
| Ohio | 547 | 563 | 211 | 175 | 481 | 76.2 | 30 | 77.6 | 2,397 | 2,677 | 766 | 140 | 316 | 985 |
| Oklahoma | 604 | 746 | 54 | 132 | 175 | 22.7 | 26 | 8.4 | 2,425 | 1,195 | 258 | 145 | 432 | 504 |
| Oregon | 22 | 24 | 13 | 45 | 15 | 4.0 | 59 | 86.1 | 566 | 926 | 359 | 186 | 357 | 650 |
| Pennsylvania | 291 | 232 | 64 | 20 | 123 | 19.5 | 25 | 51.9 | 1 | 1,669 | 1,308 | 33 | 171 | 964 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rhode Island | 0 | 1 | 1 | 1 | 6 | 0.0 | 1 | 32.0 | 11 | 40 | 14 | 4 | 6 | 11 |
| South Carolina | 9 | 82 | 21 | 70 | 68 | 13.3 | 12 | 3.5 | 567 | 1,365 | 311 | 35 | 37 | 42 |
| South Dakota | 243 | 323 | 230 | 14 | 86 | 6.1 | 3 | 1.6 | 1,560 | 238 | 194 | 23 | 21 | 80 |
| Tennessee | 258 | 216 | 14 | 252 | 133 | 8.0 | 56 | 34.0 | 1,559 | 737 | 116 | 54 | 87 | 391 |
| Texas | 444 | 515 | 100 | 248 | 358 | 45.5 | 226 | 69.8 | 4,727 | 9,284 | 4,132 | 965 | 2,730 | 13,676 |
| Utah | 13 | 17 | 12 | 8 | 6 | 0.7 | 127 | 95.6 | 1,855 | 1,086 | 361 | 286 | 170 | 95 |
| Vermont | 8 | 8 | 4 | 4 | 3 | 0.3 | 1 | 0.6 | 3 | 77 | 32 | 10 | 13 | 6 |
| Virginia [1] | | | | | | | | | | | | | | |
| Washington | 85 | 88 | 15 | 101 | 118 | 25.2 | 76 | 81.0 | 936 | 1,520 | 967 | 310 | 308 | 242 |
| West Virginia | 92 | 110 | 44 | 207 | 36 | 8.2 | 117 | 24.1 | 2,074 | 1,810 | 101 | 35 | 41 | 49 |
| Wisconsin | 214 | 225 | 58 | 30 | 214 | 25.6 | 76 | 8.7 | 247 | 3,515 | 368 | 118 | 54 | 152 |
| Wyoming | 33 | 39 | 18 | 23 | 17 | 2.6 | 23 | 19.0 | 168 | 275 | 164 | 40 | 36 | 227 |
| Total | 9,099 | 9,944 | 3,288 | 4,786 | 6,459 | 807.9 | 1,800 | 1,587.3 | 69,494 | 85,159 | 35,327 | 6,983 | 13,329 | 28,428 |

[1] Inadequate information.

TABLE 8.—*Sewerage works needs—Estimated cost of various elements and status of projects, by States and size of community*

| State | Sewers, cost | Treatment cost | Miscellaneous cost | Ready for construction | | Planning in progress | | Projects for future | | Total cost |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cost | Percent | Cost | Percent | Cost | Percent | |
| | *Thousands* | *Thousands* | *Thousands* | *Thousands* | | *Thousands* | | *Thousands* | | *Thousands* |
| Alabama | $15,502 | $15,538 | $131 | $2,884 | 9.3 | $4,992 | 16.0 | $23,295 | 74.7 | 31,171 |
| Arizona | 6,938 | 3,885 | 16 | 1,432 | 13.2 | 1,550 | 14.3 | 7,857 | 72.5 | 10,839 |
| Arkansas | 13,344 | 12,747 | 65 | 204 | 0.8 | 2,198 | 8.4 | 23,754 | 90.8 | 26,156 |
| California | 74,225 | 57,355 | 1,182 | 3,037 | 2.3 | 96,927 | 73.1 | 32,798 | 24.6 | 132,762 |
| Colorado | 4,404 | 6,043 | | 63 | 0.7 | 2,402 | 19.3 | 8,382 | 80.0 | 10,447 |
| Connecticut | 24,236 | 14,958 | | 6,455 | 16.5 | 16,740 | 42.7 | 15,999 | 40.8 | 39,194 |
| Delaware | 4,540 | 3,485 | 2 | 75 | 0.9 | 3,538 | 44.1 | 4,414 | 55.0 | 8,027 |
| Dist. of Columbia | 9,338 | 1,815 | 75 | 860 | 7.7 | 2,748 | 24.5 | 7,620 | 67.8 | 11,228 |
| Florida | 45,798 | 26,804 | 786 | 233 | 0.0 | 34,518 | 47.0 | 38,867 | 53.0 | 73,388 |
| Georgia [1] | 28,043 | 19,886 | 121 | 4,531 | 9.4 | 7,566 | 15.7 | 35,953 | 74.9 | 48,050 |
| Idaho | 6,775 | 5,153 | | 440 | 3.7 | 1,250 | 10.5 | 10,238 | 85.8 | 11,928 |
| Illinois | 190,301 | 46,201 | 34 | 34,728 | 14.7 | 74,573 | 31.6 | 127,235 | 53.7 | 236,536 |
| Indiana | 56,794 | 34,474 | 41 | 17,327 | 18.9 | 29,730 | 32.6 | 44,252 | 48.5 | 91,309 |
| Iowa | 34,825 | 29,827 | 1,590 | 2,188 | 3.3 | 12,914 | 19.5 | 51,140 | 77.2 | 66,242 |
| Kansas | 32,847 | 17,040 | 94 | 784 | 1.6 | 8,020 | 16.0 | 41,177 | 82.4 | 49,981 |
| Kentucky | 22,443 | 17,496 | 471 | 1,395 | 3.7 | 9,343 | 23.1 | 29,672 | 73.2 | 40,410 |
| Louisiana | 23,964 | 12,847 | 845 | 3,577 | 9.5 | 6,267 | 16.7 | 27,812 | 73.8 | 37,656 |
| Maine | 11,937 | 8,022 | 29 | 198 | 1.0 | 806 | 4.0 | 18,984 | 95.0 | 19,988 |
| Maryland | 34,731 | 8,875 | | 2,760 | 6.3 | 22,472 | 51.4 | 18,374 | 42.3 | 43,606 |
| Massachusetts | 42,503 | 25,023 | 2,732 | 8,773 | 12.5 | 20,260 | 28.8 | 41,225 | 58.7 | 70,258 |
| Michigan | 111,146 | 37,499 | 4,451 | 43,574 | 28.4 | 73,698 | 48.2 | 35,824 | 23.4 | 153,096 |
| Minnesota | 36,810 | 19,413 | 29 | 3,596 | 6.4 | 13,537 | 24.1 | 39,119 | 69.5 | 56,252 |
| Mississippi | 11,293 | 9,488 | 111 | 1,524 | 7.3 | 8,134 | 38.9 | 11,234 | 53.8 | 20,892 |
| Missouri | 57,941 | 62,161 | 30 | 22,976 | 19.1 | 15,677 | 13.6 | 81,479 | 67.3 | 120,132 |
| Montana | 4,519 | 4,231 | 15 | 247 | 2.8 | 2,717 | 31.0 | 5,801 | 66.2 | 8,765 |
| Nebraska | 13,183 | 14,517 | 1,311 | 523 | 1.8 | 4,409 | 15.2 | 24,079 | 83.0 | 29,011 |
| Nevada | 1,539 | 860 | 5 | 181 | 8.2 | 110 | 5.0 | 1,913 | 86.8 | 2,204 |
| New Hampshire | 4,140 | 6,025 | | 0 | 0.0 | 0 | 0.0 | 10,165 | 100.0 | 10,165 |
| New Jersey | 88,120 | 60,567 | 709 | 8,684 | 5.8 | 59,313 | 39.7 | 81,399 | 54.5 | 149,396 |
| New Mexico | 4,842 | 6,298 | 7 | 396 | 3.6 | 1,344 | 12.1 | 9,407 | 84.3 | 11,147 |
| New York | 905,051 | 195,094 | 158 | 110,416 | 10.0 | 89,865 | 8.2 | 900,022 | 81.8 | 1,100,303 |
| North Carolina | 25,201 | 39,674 | 535 | 8,998 | 13.7 | 14,887 | 22.8 | 41,525 | 63.5 | 65,410 |
| North Dakota | 7,417 | 4,707 | 3 | 795 | 6.5 | 2,549 | 20.9 | 8,783 | 72.6 | 12,127 |
| Ohio | 59,895 | 75,974 | 1,137 | 24,654 | 18.0 | 46,078 | 33.5 | 66,274 | 48.5 | 137,006 |
| Oklahoma | 17,351 | 18,902 | 23 | 1,242 | 3.4 | 13,366 | 36.8 | 21,668 | 59.8 | 36,276 |
| Oregon | 17,386 | 12,564 | | 21 | 0.1 | 18,492 | 61.5 | 11,437 | 38.4 | 29,950 |
| Pennsylvania | 209,082 | 131,516 | 351 | 9,396 | 2.8 | 76,586 | 22.4 | 254,967 | 74.8 | 340,949 |
| Rhode Island | 6,015 | 2,902 | | 0 | 0.0 | 2,650 | 29.7 | 6,267 | 70.3 | 8,917 |
| South Carolina | 12,578 | 9,879 | 27 | 6,663 | 29.8 | 3,293 | 14.7 | 12,528 | 55.5 | 22,484 |
| South Dakota | 4,777 | 5,524 | | 130 | 1.2 | 921 | 8.9 | 9,250 | 85.9 | 10,301 |
| Tennessee | 33,075 | 17,047 | 128 | 123 | 0.2 | 7,627 | 15.2 | 42,500 | 84.6 | 50,250 |
| Texas | 47,097 | 31,176 | 767 | 8,856 | 11.2 | 20,769 | 26.2 | 49,415 | 62.6 | 79,040 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Utah | 18,343 | 9,380 | [2] | 3,617 | 13.0 | 3,490 | 12.6 | 20,626 | 74.4 | 27,733 |
| Vermont | 1,444 | 2,824 | 29 | 0 | 0.0 | 295 | 6.9 | 4,092 | 93.1 | 4,297 |
| Virginia [1] | 28,285 | 22,844 | 195 | 3,467 | 6.8 | 16,490 | 32.2 | 31,367 | 61.0 | 51,324 |
| Washington | 28,141 | 17,360 | 115 | 5,292 | 11.6 | 19,591 | 42.8 | 20,733 | 45.6 | 45,616 |
| West Virginia | 33,188 | 30,068 | 252 | 858 | 1.3 | 16,211 | 25.0 | 46,459 | 73.2 | 63,508 |
| Wisconsin | 20,693 | 11,496 | 136 | 2,531 | 6.7 | 17,310 | 45.3 | 18,484 | 48.0 | 38,325 |
| Wyoming | 2,087 | 2,714 | | 55 | 1.2 | 225 | 4.6 | 4,521 | 94.2 | 4,801 |
| Total | 2,499,927 | 1,230,188 | 18,738 | 360,509 | 9.6 | 908,048 | 24.2 | 2,480,296 | 66.2 | 3,748,853 |
| Size of community: | | | | | | | | | | |
| 200–500 | 160,477 | 103,229 | 266 | 1,227 | 0.5 | 15,128 | 5.7 | 247,617 | 93.8 | 263,972 |
| 500–1,000 | 133,817 | 84,059 | 587 | 10,291 | 4.7 | 34,685 | 15.9 | 173,487 | 79.4 | 218,463 |
| 1,000–5,000 | 307,352 | 249,502 | 1,828 | 31,276 | 5.6 | 105,933 | 18.9 | 421,473 | 75.5 | 558,682 |
| 5,000–10,000 | 116,996 | 101,431 | 1,238 | 22,435 | 10.2 | 74,125 | 33.8 | 123,105 | 55.0 | 219,665 |
| 10,000–25,000 | 120,921 | 114,643 | 1,930 | 31,388 | 13.2 | 88,789 | 37.4 | 117,317 | 49.4 | 237,494 |
| 25,000–50,000 | 90,015 | 70,061 | 1,026 | 19,861 | 12.3 | 58,404 | 36.2 | 82,837 | 51.5 | 161,102 |
| 50,000–100,000 | 96,035 | 79,272 | 1,919 | 6,244 | 3.5 | 92,958 | 52.5 | 78,024 | 44.0 | 177,226 |
| Over 100,000 | 1,474,314 | 427,991 | 9,944 | 237,787 | 12.4 | 438,026 | 22.9 | 1,236,436 | 64.7 | 1,912,249 |

[1] Figures for Georgia and Virginia estimated on basis of costs in adjacent States because of inadequate surveys. They are included in order to obtain national totals.
[2] Less than 1/10 of 1 percent.

TABLE 9.—*Sewerage works needs—quantities of various elements, by States*

| State | Sewers (length in thousands of feet) | | | | | | | | Number of treatment plants | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8-inch diameter or smaller | 10-inch diameter | 12-inch diameter | 15-inch diameter | 18-inch diameter | 21-inch diameter | 24-inch diameter | Over 24-inch diameter | Primary | Secondary | Complete | Additions to existing plants | Total |
| Alabama | 5,096 | 686 | 321 | 145 | 53 | 22 | 16 | 132 | 66 | 75 | 121 | 6 | 268 |
| Arizona | 2,100 | 180 | 52 | 28 | 10 | | 11 | | 46 | 6 | 18 | 3 | 73 |
| Arkansas | 7,208 | 327 | 122 | 82 | 43 | 1 | 12 | 18 | 63 | 10 | 336 | 1 | 410 |
| California | 7,464 | 1,031 | 446 | 447 | 195 | 78 | 301 | 349 | 126 | 2 | 138 | 57 | 323 |
| Colorado | 1,733 | 309 | 109 | 48 | 18 | 1 | 2 | | 120 | 6 | 109 | 10 | 245 |
| Connecticut | 2,348 | 480 | 535 | 322 | 126 | 20 | 97 | 263 | 19 | 2 | 46 | 5 | 72 |
| Delaware | 503 | 75 | 52 | | 4 | | 1 | 165 | 20 | 0 | 2 | 5 | 27 |
| District of Columbia [1] | | | | | | | | | | | | | |
| Florida | 9,602 | 1,094 | 782 | 390 | 266 | 56 | 147 | 349 | 62 | 29 | 109 | 2 | 193 |
| Georgia [1] | | | | | | | | | | | | | |
| Idaho | 2,216 | 394 | 271 | 73 | 55 | 4 | 36 | 38 | 162 | 1 | 12 | 0 | 175 |
| Illinois | 12,370 | 1,992 | 1,326 | 436 | 644 | 204 | 430 | 1,497 | 71 | 24 | 559 | 52 | 706 |
| Indiana | 9,149 | 1,471 | 665 | 192 | 264 | 48 | 211 | 623 | 6 | 19 | 521 | 58 | 604 |
| Iowa | 7,807 | 1,565 | 313 | 172 | 169 | 35 | 140 | 230 | 35 | 17 | 493 | 82 | 627 |
| Kansas | 5,873 | 1,032 | 932 | 268 | 326 | 175 | 160 | 371 | 12 | 23 | 404 | 40 | 479 |
| Kentucky | 4,729 | 902 | 221 | 245 | 106 | 47 | 132 | 671 | 140 | 25 | 311 | 8 | 484 |
| Louisiana | 5,426 | 738 | 338 | 212 | 176 | 61 | 143 | 351 | 37 | 6 | 93 | 6 | 142 |
| Maine | 1,119 | 60 | 501 | 21 | 330 | 20 | 193 | 167 | 149 | 0 | 11 | 0 | 160 |
| Maryland | 1,780 | 266 | 239 | 160 | 452 | 174 | 390 | 465 | 37 | 2 | 21 | 1 | 61 |
| Massachusetts | 3,103 | 1,016 | 1,188 | 478 | 220 | 71 | 191 | 208 | 46 | 3 | 2 | 3 | 114 |
| Michigan | 7,142 | 3,382 | 1,714 | 425 | 623 | 80 | 377 | 1,212 | 251 | 7 | 136 | 28 | 422 |
| Minnesota | 6,859 | 1,337 | 1,000 | 350 | 287 | 15 | 140 | 95 | | 46 | 527 | 35 | 608 |
| Mississippi | 4,352 | 379 | 252 | 49 | 39 | 67 | 108 | 54 | 105 | 2 | 71 | 20 | 198 |
| Missouri | 7,472 | 3,218 | 1,053 | 856 | 68 | 27 | 360 | 321 | 75 | 28 | 528 | 33 | 664 |
| Montana | 1,353 | 262 | 105 | 51 | 35 | 12 | 5 | 16 | 120 | | 35 | 1 | 156 |
| Nebraska | 3,582 | 362 | 40 | 18 | 40 | 17 | 35 | 110 | 3 | 25 | 303 | 16 | 347 |
| Nevada | 396 | 57 | 41 | 4 | 13 | 0 | 0 | 0 | 24 | | 8 | 1 | 33 |
| New Hampshire | 739 | 315 | 74 | 64 | 5 | 3 | 16 | 3 | 12 | 3 | 42 | 2 | 59 |
| New Jersey | 7,394 | 1,296 | 1,184 | 667 | 337 | 211 | 370 | 504 | 15 | 7 | 142 | 42 | 206 |
| New Mexico | 1,317 | 259 | 141 | 16 | 33 | 0 | 0 | 0 | 16 | 1 | 117 | 1 | 135 |
| New York | 82,262 | 2,651 | 10,691 | 3,159 | 1,513 | 49 | 1,004 | 6,507 | 288 | 15 | 408 | 42 | 753 |
| North Carolina | 6,344 | 1,080 | 413 | 130 | 282 | 1 | 186 | 199 | 310 | 9 | 86 | 38 | 443 |
| North Dakota | 1,843 | 284 | 153 | 6 | | | | | 197 | 2 | 39 | 18 | 256 |
| Ohio | 10,451 | 1,528 | 1,158 | 571 | 532 | 342 | 568 | 916 | 60 | 30 | 505 | 110 | 705 |
| Oklahoma | 4,632 | 634 | 190 | 152 | 93 | 23 | 46 | 173 | 28 | 64 | 141 | 30 | 263 |
| Oregon | 2,388 | 455 | 144 | 27 | 30 | 16 | 79 | 123 | 86 | | 121 | 12 | 219 |
| Pennsylvania | 12,678 | 4,035 | 2,159 | 1,030 | 334 | 158 | 417 | 1,193 | 168 | 23 | 288 | 25 | 504 |
| Rhode Island | 1,466 | 306 | 173 | 184 | 155 | | 97 | 40 | 1 | 3 | 2 | 8 | 14 |
| South Carolina | 4,033 | 356 | 439 | 66 | 45 | 11 | 26 | 0 | 88 | 1 | 46 | 16 | 154 |
| South Dakota | 2,297 | 163 | 24 | 0 | 0 | 0 | 0 | 0 | 10 | 37 | 179 | 20 | 246 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tennessee | [illegible] | 298 | 529 | 134 | 38 | 305 | 52 | 335 | 23 | 40 | 79 | 4 | 146 |
| Texas | [illegible] | 1,919 | 725 | 392 | 180 | 46 | 205 | 369 | 243 | 55 | 273 | 107 | 678 |
| Utah | [illegible] | 1,331 | 765 | 377 | 147 | 16 | | | 91 | | 106 | 4 | 201 |
| Vermont | 98 | 53 | 89 | 23 | 25 | 1 | 11 | 23 | 21 | | 14 | | 35 |
| Virginia [1] | 4,551 | 781 | 814 | 352 | 118 | 49 | 146 | 488 | 103 | 2 | 243 | 28 | 376 |
| Washington | 3,313 | 859 | 423 | 352 | 153 | 27 | 122 | 280 | 226 | | 313 | | 539 |
| West Virginia | 4,383 | 808 | 428 | 275 | 147 | 65 | 103 | 253 | 36 | 2 | 265 | 42 | 345 |
| Wisconsin | 982 | 221 | 71 | 20 | 2 | | | | 75 | | 8 | 1 | 84 |
| Wyoming | | | | | | | | | | | | | |
| Total | 280,446 | 41,957 | 33,156 | 13,467 | 8,731 | 2,558 | 7,066 | 19,320 | 3,892 | 646 | 8,391 | 1,023 | 13,952 |

[1] Information inadequate.

TABLE 10.—*Sewerage works needs—Number and population of communities with and without reported needs including cost of new systems and improvements to existing systems, by State and by size of community*

| State | New systems | | | | Improvements to existing systems | | | | No needs reported | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of communities | Population [1] | Cost | Cost per capita | Number of communities | Population [1] | Cost | Cost per capita | Number of communities | Population [1] | Number of communities | Population [1] | Cost | Cost per capita |
| | | *Thousands* | *Thousands* | | | *Thousands* | *Thousands* | | | *Thousands* | | *Thousands* | *Thousands* | |
| Alabama | 222 | 137 | $87,444 | $54 | 134 | 946 | $23,727 | $25 | 278 | 102 | 634 | 1,185 | $31,171 | $26 |
| Arizona | 51 | 42 | 4,741 | 113 | 34 | 202 | 6,098 | 30 | 79 | 35 | 164 | 279 | 10,839 | 39 |
| Arkansas | 409 | 184 | 16,590 | 89 | 85 | 489 | 9,866 | 20 | 3 | 16 | 497 | 689 | 26,156 | 38 |
| California | 177 | 102 | 9,792 | 96 | 869 | 5,728 | 122,970 | 21 | 83 | 26 | 1,129 | 5,856 | 132,762 | 23 |
| Colorado | 170 | 77 | 5,061 | 66 | 136 | 691 | 5,396 | 78 | | | 306 | 768 | 10,447 | 14 |
| Connecticut | 19 | 182 | 12,781 | 70 | 74 | 1,255 | 26,413 | 21 | 74 | 198 | 167 | 1,635 | 39,194 | 24 |
| Delaware | 19 | 12 | 990 | 82 | 28 | 167 | 7,037 | 42 | 31 | 12 | 78 | 191 | 8,027 | 42 |
| District of Columbia | | | | | 1 | 663 | 11,228 | 17 | | | 1 | 663 | 11,228 | 17 |
| Florida | 107 | 109 | 13,630 | 125 | 156 | 1,075 | 59,758 | 56 | 285 | 114 | 528 | 1,298 | 73,388 | 57 |
| Georgia [2] | 185 | 179 | 14,722 | 86 | 178 | 1,172 | 33,328 | 28 | 346 | 155 | 709 | 1,498 | 48,050 | 32 |
| Idaho | 111 | 57 | 4,036 | 71 | 102 | 219 | 7,892 | 36 | 16 | 5 | 229 | 281 | 11,928 | 43 |
| Illinois | 492 | 267 | 29,986 | 101 | 432 | 6,407 | 206,550 | 34 | 312 | 239 | 1,236 | 6,543 | 236,536 | 36 |
| Indiana | 359 | 270 | 25,731 | 95 | 316 | 2,053 | 65,578 | 32 | 94 | 28 | 769 | 2,351 | 91,309 | 39 |
| Iowa | 409 | 292 | 23,182 | 114 | 405 | 1,345 | 43,060 | 32 | | | 805 | 1,547 | 66,242 | 43 |
| Kansas | 368 | 138 | 17,270 | 125 | 195 | 919 | 32,711 | 36 | 20 | 6 | 583 | 1,063 | 49,981 | 47 |
| Kentucky | 252 | 167 | 12,115 | 73 | 217 | 1,038 | 28,295 | 27 | 159 | 69 | 728 | 1,274 | 40,410 | 32 |
| Louisiana | 125 | 150 | 9,910 | 66 | 86 | 1,010 | 27,746 | 27 | 295 | 122 | 506 | 1,282 | 37,656 | 29 |
| Maine | 54 | 65 | 1,802 | 28 | 215 | 673 | 18,186 | 27 | 141 | 91 | 410 | 829 | 19,988 | 24 |
| Maryland | 42 | 13 | 1,338 | 103 | 56 | 1,216 | 42,268 | 35 | 234 | 174 | 332 | 1,403 | 43,606 | 31 |
| Massachusetts | 48 | 190 | 9,456 | 50 | 116 | 3,351 | 60,802 | 18 | 179 | 775 | 343 | 4,316 | 70,258 | 16 |
| Michigan | 186 | 108 | 12,823 | 118 | 335 | 3,742 | 140,273 | 37 | 281 | 104 | 802 | 3,954 | 153,096 | 39 |
| Minnesota | 351 | 145 | 26,404 | 182 | 316 | 1,615 | 29,848 | 18 | 14 | 22 | 681 | 1,782 | 56,252 | 32 |
| Mississippi | 82 | 68 | 5,217 | 77 | 134 | 522 | 15,675 | 30 | 226 | 67 | 442 | 657 | 20,892 | 32 |
| Missouri | 469 | 217 | 16,065 | 74 | 253 | 2,193 | 104,067 | 48 | 19 | 41 | 751 | 2,451 | 130,132 | 49 |
| Montana | 99 | 38 | 4,009 | 105 | 76 | 273 | 4,756 | 17 | 26 | 7 | 201 | 318 | 8,765 | 28 |
| Nebraska | 218 | 80 | 9,826 | 123 | 193 | 687 | 19,185 | 28 | 15 | 6 | 426 | 773 | 29,011 | 38 |
| Nevada | 6 | 4 | 296 | 74 | 36 | 83 | 1,308 | 30 | 19 | 16 | 61 | 83 | 2,304 | 27 |
| New Hampshire | 45 | 54 | 4,305 | 80 | 33 | 241 | 5,860 | 24 | 132 | 186 | 210 | 481 | 10,165 | 21 |
| New Jersey | 70 | 188 | 27,870 | 148 | 382 | 3,216 | 121,526 | 38 | 164 | 504 | 616 | 3,908 | 149,396 | 38 |
| New Mexico | 118 | 70 | 6,810 | 97 | 49 | 156 | 4,357 | 28 | 51 | 58 | 218 | 284 | 11,147 | 39 |
| New York | 672 | 621 | 73,309 | 118 | 388 | 11,022 | 1,027,003 | 93 | 332 | 432 | 1,392 | 12,075 | 1,100,303 | 92 |
| North Carolina | 200 | 75 | 9,310 | 124 | 351 | 1,235 | 56,100 | 45 | 272 | 223 | 823 | 1,533 | 65,410 | 43 |
| North Dakota | 198 | 71 | 7,200 | 101 | 84 | 199 | 4,927 | 25 | 4 | 8 | 286 | 278 | 12,127 | 44 |
| Ohio | 415 | 278 | 33,080 | 119 | 397 | 4,735 | 104,005 | 22 | 436 | 265 | 1,248 | 5,278 | 137,086 | 26 |
| Oklahoma | 320 | 134 | 11,661 | 87 | 229 | 1,050 | 24,615 | 23 | 7 | 2 | 556 | 1,186 | 36,276 | 31 |
| Oregon | 115 | 52 | 5,854 | 51 | 158 | 617 | 24,096 | 39 | 18 | 14 | 291 | 683 | 29,950 | 44 |
| Pennsylvania | 211 | 569 | 76,593 | 127 | 443 | 6,237 | 264,446 | 43 | 1,455 | 1,284 | 2,109 | 8,120 | 340,949 | 42 |
| Rhode Island | 3 | 38 | 634 | 167 | 17 | 581 | 8,283 | 14 | 19 | 94 | 39 | 713 | 8,917 | 13 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South Carolina | 68 | 61 | [illegible] | 67 | 148 | 836 | 18,465 | 29 | 189 | 89 | 405 | 786 | 22,484 | 29 |
| South Dakota | 128 | 30 | 5,209 | 105 | 137 | 249 | 5,072 | 20 | | | 265 | 286 | 10,301 | 34 |
| Tennessee | 105 | 165 | [illegible] | 120 | 53 | 999 | 30,340 | 31 | 399 | 157 | 557 | 1,311 | 50,250 | 38 |
| Texas | 305 | 228 | 21,439 | 95 | 472 | 3,308 | 57,639 | 17 | 550 | 197 | 1,427 | 2,731 | 78,040 | 21 |
| Utah | 147 | 102 | 15,915 | 136 | 81 | 348 | 11,818 | 34 | 43 | 11 | 271 | 451 | 27,733 | 60 |
| Vermont | 2 | 4 | 62 | 16 | 133 | 272 | 4,234 | 16 | 94 | 88 | 227 | 364 | 4,297 | 12 |
| Virginia [2] | 133 | 52 | 5,078 | 98 | 231 | 1,046 | 46,246 | 44 | 264 | 152 | 628 | 1,250 | 51,324 | 41 |
| Washington | 186 | 71 | 10,845 | 153 | 243 | 1,027 | 34,771 | 32 | 29 | 14 | 457 | 1,102 | 45,616 | 39 |
| West Virginia | 179 | 105 | [illegible] | 78 | 443 | 878 | 35,089 | 63 | 274 | 106 | 886 | 1,004 | 63,308 | 59 |
| Wisconsin | 257 | 108 | [illegible] | 102 | 230 | 1,807 | 27,165 | 15 | 174 | 126 | 661 | 2,041 | 38,325 | 19 |
| Wyoming | 26 | 16 | 1 | 26 | 52 | 139 | 3,263 | 24 | 9 | 3 | 97 | 155 | 4,801 | 31 |
| Total | 9,139 | 6,209 | 654,336 | 162 | 9,972 | 79,349 | 3,084,463 | 39 | 8,126 | 6,443 | 27,197 | 92,152 | 3,748,853 | 41 |
| Size of community: | | | | | | | | | | | | | | |
| 200–500 | 5,514 | 1,743 | 216,301 | 124 | 1,780 | 329 | 47,671 | 90 | 6,336 | 1,859 | 13,620 | 4,112 | 283,972 | 64 |
| 500–1,000 | 2,381 | 1,643 | 162,302 | 99 | 1,961 | 1,271 | 56,104 | 44 | 951 | 658 | 5,213 | 3,574 | 218,463 | 61 |
| 1,000–5,000 | 1,164 | 2,291 | 231,254 | 105 | 4,347 | 9,463 | 327,428 | 35 | 717 | 1,448 | 6,227 | 13,112 | 558,682 | 43 |
| 5,000–10,000 | 63 | 402 | 36,453 | 79 | 930 | 6,419 | 182,712 | 28 | 68 | 467 | 1,041 | 7,351 | 219,665 | 30 |
| 10,000–25,000 | 16 | 242 | 5,305 | 22 | 805 | 9,144 | 252,289 | 25 | 51 | 728 | 672 | 10,114 | 237,494 | 23 |
| 25,000–50,000 | 2 | 63 | 2,375 | 28 | 198 | 6,810 | 178,727 | 23 | 12 | 440 | 212 | 7,313 | 161,102 | 22 |
| 50,000–100,000 | | | | | 100 | 6,953 | 177,225 | 25 | 9 | 626 | 109 | 7,581 | 177,226 | 23 |
| Over 100,000 | | | | | 91 | 38,758 | 1,912,249 | 49 | 2 | 237 | 93 | 38,905 | 1,912,249 | 49 |

[1] Populations obtained from 1940 census. Community populations include both incorporated and unincorporated communities. Where more than one community was served by a single water or sewerage system they were considered as a single community.

[2] Figures for Georgia and Virginia estimated on basis of costs in adjacent States because of inadequate survey. They are included in order to obtain national totals.

TABLE 11.—*Garbage and refuse disposal needs—Quantities and costs of various elements and number and population of communities with and without needs, by State and by size of community*

| States | Collection trucks | | Incinerators | | Land fill installations | | Miscellaneous garbage, land, etc. | Communities with needs reported | | | | Communities with no needs reported | | Total population [1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Costs | Number | Costs | Number | Costs | | Number of communities | Population [1] | Cost | Cost per capita | Number of communities | Population [1] | |
| | | *Thousands* | | *Thousands* | | *Thousands* | *Thousands* | | *Thousands* | *Thousands* | | | *Thousands* | |
| Alabama | 253 | $714 | | | 117 | $457 | | 208 | 800 | $1,171 | $1.40 | 426 | 325 | 1,185 |
| Arizona | 50 | 137 | 2 | $300 | 40 | 166 | $61 | 61 | 165 | 564 | 3.40 | 103 | 114 | 279 |
| Arkansas | 161 | 517 | | | 119 | 853 | 696 | 114 | 518 | 1,866 | 3.60 | 353 | 171 | 689 |
| California | 332 | 819 | 25 | 2,488 | 50 | 263 | 36 | 164 | 3,673 | 3,626 | 1.00 | 765 | 2,183 | 5,856 |
| Colorado | 89 | 244 | 8 | 195 | 67 | 245 | 19 | 83 | 577 | 703 | 1.20 | 223 | 191 | 768 |
| Connecticut | 90 | 549 | 26 | 3,177 | 14 | 64 | 10 | 43 | 1,179 | 3,797 | 3.20 | 124 | 436 | 1,635 |
| Delaware | 30 | 88 | 15 | 230 | 9 | 20 | | 22 | 159 | 338 | 2.10 | 56 | 32 | 191 |
| District of Columbia | | 829 | | 700 | | | 843 | 1 | 663 | 2,372 | 3.60 | 0 | 0 | 663 |
| Florida | 354 | 864 | 17 | 1,864 | 111 | 549 | 42 | 185 | 1,003 | 3,319 | 3.30 | 343 | 295 | 1,298 |
| Georgia [2] | | 903 | | 1,105 | | 674 | | 200 | 1,150 | 2,682 | 2.30 | 449 | 348 | 1,498 |
| Idaho | 71 | 212 | | | 40 | 250 | | 50 | 213 | 442 | 2.10 | 166 | 68 | 281 |
| Illinois | 1,451 | 3,479 | 27 | 2,113 | 618 | 2,150 | 100 | 749 | 6,278 | 7,842 | 1.20 | 487 | 265 | 6,543 |
| Indiana | 504 | 1,924 | 8 | 606 | 384 | 1,125 | 181 | 429 | 2,204 | 3,838 | 1.70 | 310 | 147 | 2,351 |
| Iowa | 291 | 792 | 5 | 125 | 230 | 713 | 236 | 204 | 1,023 | 1,864 | 1.80 | 601 | 524 | 1,547 |
| Kansas | 234 | 1,067 | 4 | 98 | 130 | 705 | 403 | 142 | 866 | 2,273 | 2.60 | 441 | 197 | 1,063 |
| Kentucky | 275 | 997 | 19 | 581 | 207 | 587 | | 282 | 1,011 | 1,965 | 1.90 | 446 | 263 | 1,274 |
| Louisiana | 395 | 787 | 1 | 1,117 | 321 | 861 | 1 | 211 | 1,114 | 2,866 | 2.60 | 296 | 168 | 1,282 |
| Maine | 10 | 64 | 14 | 351 | | | | 12 | 238 | 415 | 1.70 | 398 | 391 | 829 |
| Maryland | 259 | 755 | 32 | 1,577 | 1 | 42 | 201 | 53 | 1,177 | 2,575 | 2.20 | 279 | 226 | 1,403 |
| Massachusetts | 184 | 1,028 | 39 | 4,424 | 8 | 87 | 200 | 58 | 2,346 | 5,750 | 2.50 | 285 | 1,970 | 4,316 |
| Michigan | 497 | 2,082 | 21 | 1,576 | 140 | 536 | 577 | 280 | 3,516 | 4,771 | 1.40 | 505 | 438 | 3,954 |
| Minnesota | 397 | 1,832 | 2 | 900 | 191 | 1,102 | 350 | 210 | 1,505 | 4,214 | 2.80 | 471 | 277 | 1,782 |
| Mississippi | 79 | 221 | | | 145 | 1,134 | | 157 | 506 | 1,372 | 2.70 | 285 | 148 | 657 |
| Missouri | 477 | 1,953 | 2 | 1,320 | 192 | 1,129 | 235 | 213 | 2,219 | 4,895 | 2.20 | 532 | 232 | 2,451 |
| Montana | 56 | 213 | | | 25 | 110 | | 45 | 167 | 323 | 1.90 | 156 | 151 | 318 |
| Nebraska | 241 | 1,059 | | | 178 | 771 | | 111 | 630 | 1,830 | 2.90 | 315 | 143 | 773 |
| Nevada | 34 | 96 | | | 12 | 41 | 11 | 15 | 59 | 148 | 2.50 | 46 | 24 | 83 |
| New Hampshire | | | 3 | 120 | | | | 2 | 46 | 120 | 2.60 | 268 | 435 | 481 |
| New Jersey | 237 | 1,701 | 80 | 6,235 | 48 | 159 | 23 | 125 | 2,440 | 8,208 | 3.40 | 480 | 1,459 | 3,908 |
| New Mexico | 68 | 238 | | | 37 | 178 | | 48 | 161 | 416 | 2.60 | 171 | 123 | 284 |
| New York | 1,409 | 7,577 | 460 | 14,415 | 120 | 1,008 | 15,800 | 940 | 11,020 | 38,800 | 3.50 | 452 | 1,005 | 12,075 |
| North Carolina | 318 | 863 | 77 | 4,224 | 109 | 612 | | 311 | 902 | 5,729 | 6.40 | 513 | 631 | 1,533 |
| North Dakota | 56 | 320 | 3 | 173 | 36 | 175 | | 47 | 173 | 718 | 4.10 | 239 | 105 | 278 |
| Ohio | 1,150 | 3,247 | 42 | 5,405 | 598 | 1,716 | 508 | 620 | 4,819 | 10,876 | 2.30 | 578 | 459 | 5,278 |
| Oklahoma | 344 | 1,301 | 2 | 87 | 182 | 1,300 | 323 | 183 | 1,031 | 3,160 | 3.10 | 373 | 155 | 1,186 |
| Oregon | 40 | 91 | 8 | 529 | 31 | 79 | | 31 | 407 | 690 | 1.70 | 260 | 276 | 683 |
| Pennsylvania | 218 | 1,758 | 50 | 7,514 | 23 | 122 | | 75 | 4,454 | 9,394 | 2.10 | 2,053 | 3,666 | 8,120 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rhode Island | | | 5 | 341 | | | | 4 | 156 | 341 | 2.20 | 35 | 557 | 713 |
| South Carolina | 116 | 329 | 38 | 847 | 66 | 424 | | 142 | 573 | 1,600 | 2.80 | 263 | 213 | 786 |
| South Dakota | 74 | 285 | | | 35 | 375 | | 57 | 213 | 660 | 3.10 | 198 | 86 | 290 |
| Tennessee | 272 | 923 | 4 | 1,986 | 115 | 519 | | 156 | 1,164 | 3,428 | 2.90 | 401 | 147 | 1,311 |
| Texas | 468 | 1,616 | 2 | 1,080 | 240 | 1,133 | 9 | 353 | 2,973 | 3,838 | 1.30 | 1,074 | 758 | 3,731 |
| Utah | 87 | 235 | 1 | 58 | 70 | 253 | | 77 | 213 | 546 | 2.60 | 194 | 248 | 461 |
| Vermont | | | 1 | 250 | | | | 1 | 28 | 250 | 8.90 | 226 | 536 | 364 |
| Virginia [2] | | 642 | | 1,923 | | 246 | | 129 | 859 | 2,809 | 3.30 | 499 | 391 | 1,250 |
| Washington | 208 | 1,172 | 3 | 136 | 123 | 477 | 539 | 158 | 975 | 2,315 | 2.40 | 299 | 187 | 1,162 |
| West Virginia | 117 | 558 | 10 | 682 | 48 | 187 | | 98 | 521 | 1,427 | 2.70 | 798 | 563 | 1,084 |
| Wisconsin | 406 | 1,448 | 14 | 853 | 319 | 685 | 22 | 359 | 1,750 | 2,986 | 1.70 | 302 | 291 | 2,041 |
| Wyoming | 43 | 130 | | | 31 | 173 | | 32 | 125 | 303 | 2.40 | 65 | 30 | 155 |
| Total | 12,535 | 48,920 | 1,090 | 71,993 | 5,549 | 24,678 | 21,285 | 8,389 | 70,084 | 168,526 | 2.40 | 18,611 | 22,068 | 92,152 |
| Size of community: | | | | | | | | | | | | | | |
| 200–500 | | | | | | | | 1,385 | 452 | 6,842 | 15.10 | 12,255 | 3,663 | 4,115 |
| 500–1,000 | | | | | | | | 1,528 | 1,152 | 8,589 | 7.50 | 3,398 | 2,424 | 3,576 |
| 1,000–5,000 | | | | | | | | 3,942 | 8,294 | 33,631 | 4.10 | 2,309 | 4,821 | 13,115 |
| 5,000–10,000 | | | | | | | | 727 | 5,032 | 15,043 | 3.00 | 327 | 2,304 | 7,336 |
| 10,000–25,000 | | | | | | | | 604 | 7,350 | 18,731 | 2.50 | 183 | 2,773 | 10,123 |
| 25,000–50,000 | | | | | | | | 168 | 5,727 | 12,908 | 2.30 | 69 | 1,587 | 7,314 |
| 50,000–100,000 | | | | | | | | 76 | 5,290 | 9,327 | 1.80 | 35 | 2,290 | 7,380 |
| Over 100,000 | | | | | | | | 81 | 36,787 | 61,455 | 1.70 | 12 | 2,206 | 38,983 |

[1] Populations obtained from 1940 census. Community populations include both incorporated and unincorporated communities. Where more than one community was served by a single water or sewerage system they were considered as a single community.

[2] Figure for Georgia and Virginia estimated on basis of costs in adjacent States because of inadequate survey. They are included in order to obtain national totals.

TABLE 12.—*Rural sanitation needs—Number and cost of individual water and waste disposal facilities needed—By States (cost in thousands of dollars)*

| States | Water supplies, new or repairs | | Privies, new or repairs | | Septic tanks, new or repairs | | Total cost |
|---|---|---|---|---|---|---|---|
| | Number | Cost | Number | Cost | Number | Cost | |
| Alabama | 447,300 | 57,066 | 392,600 | 20,426 | 30,100 | 3,998 | 81,492 |
| Arizona | 30,400 | 24,225 | 20,000 | 2,000 | 4,400 | 1,100 | 27,325 |
| Arkansas | 302,000 | 33,008 | 226,400 | 17,203 | 74,000 | 18,393 | 68,604 |
| California | 50,900 | 7,852 | 20,000 | 2,012 | 61,500 | 16,444 | 26,308 |
| Colorado | 52,600 | 8,345 | 87,500 | 3,450 | 5,800 | 1,740 | 10,535 |
| Connecticut | 11,200 | 3,075 | 6,800 | 508 | 20,300 | 4,061 | 7,644 |
| Delaware | 2,500 | 494 | 3,400 | 220 | 7,500 | 1,501 | 2,218 |
| District of Columbia | | | | | | | |
| Florida | 130,200 | 16,464 | 101,100 | 5,657 | 72,500 | 9,102 | 30,623 |
| Georgia | 353,100 | 71,809 | 332,700 | 19,961 | 60,900 | 12,430 | 104,200 |
| Idaho | 26,500 | 2,753 | 34,700 | 2,082 | 3,500 | 1,044 | 5,879 |
| Illinois | 271,700 | 54,911 | 255,100 | 12,602 | 138,900 | 38,807 | 106,320 |
| Indiana | 266,500 | 22,800 | 203,000 | 10,030 | 900 | 209 | 33,129 |
| Iowa | 216,700 | 25,163 | 221,300 | 22,130 | 39,800 | 12,127 | 59,420 |
| Kansas | 131,200 | 7,654 | 176,000 | 14,775 | | | 22,429 |
| Kentucky | 272,300 | 17,575 | 332,300 | 25,358 | | | 42,933 |
| Louisiana | 191,500 | 28,300 | 201,400 | 12,887 | 48,800 | 13,066 | 54,283 |
| Maine | 37,900 | 10,412 | 13,600 | 1,021 | 40,800 | 8,165 | 19,598 |
| Maryland | 23,800 | 5,480 | 60,500 | 2,378 | 15,000 | 2,600 | 10,458 |
| Massachusetts | 8,500 | 2,338 | 6,400 | 480 | 15,000 | 3,000 | 5,818 |
| Michigan | 161,400 | 9,683 | 227,100 | 11,110 | 53,500 | 10,147 | 30,940 |
| Minnesota | 151,200 | 14,284 | 215,200 | 16,725 | 16,100 | 1,255 | 32,264 |
| Mississippi | 387,700 | 21,666 | 299,400 | 20,959 | 10,600 | 1,705 | 44,330 |
| Missouri | 297,900 | 20,943 | 190,200 | 13,101 | 2,800 | 139 | 43,183 |
| Montana | 41,800 | 5,207 | 40,000 | 2,400 | 4,000 | 1,200 | 8,807 |
| Nebraska | 121,900 | 6,264 | 126,000 | 12,660 | 13,200 | 3,972 | 22,896 |
| Nevada | 6,200 | 625 | 2,700 | 273 | 1,500 | 453 | 1,351 |
| New Hampshire | 8,200 | 2,460 | 6,500 | 488 | 15,000 | 3,000 | 5,948 |
| New Jersey | 18,500 | 9,270 | 17,000 | 872 | 40,700 | 12,205 | 22,347 |
| New Mexico | 23,100 | 5,011 | 24,000 | 1,420 | 4,000 | 1,998 | 8,429 |
| New York | 98,000 | 26,950 | 65,000 | 4,725 | 147,000 | 29,400 | 61,075 |
| North Carolina | 339,300 | 53,604 | 282,400 | 15,604 | 42,700 | 7,082 | 76,890 |
| North Dakota | 69,700 | 2,473 | 69,400 | 4,046 | | | 6,519 |
| Ohio | 352,100 | 12,237 | 269,400 | 14,451 | 26,900 | 3,773 | 30,461 |
| Oklahoma | 150,200 | 36,702 | 151,500 | 8,930 | | | 10,560 |
| Oregon | 28,900 | 3,820 | 35,000 | 3,500 | 10,800 | 3,240 | 121,931 |
| Pennsylvania | 189,600 | 49,660 | 87,000 | 6,570 | 202,800 | 65,701 | 1,684 |
| Rhode Island | 2,600 | 713 | 1,400 | 108 | 4,300 | 863 | 25,752 |
| South Carolina | 171,900 | 13,963 | 117,500 | 6,009 | 41,900 | 5,780 | 18,196 |
| South Dakota | 76,400 | 10,658 | 81,900 | 7,538 | | | 89,991 |
| Tennessee | 271,900 | 54,384 | 265,100 | 19,220 | 79,200 | 16,387 | 68,240 |
| Texas | 182,800 | 18,378 | 235,700 | 13,889 | 127,600 | 35,973 | 2,308 |
| Utah | 7,300 | 948 | 15,100 | 907 | 1,500 | 453 | 4,590 |
| Vermont | 4,600 | 1,272 | 4,900 | 364 | 14,600 | 2,914 | 47,894 |
| Virginia[1] | 218,400 | 30,570 | 219,900 | 10,876 | 39,500 | 6,448 | 18,262 |
| Washington | 45,200 | 6,627 | 57,700 | 5,770 | 23,300 | 5,865 | 22,503 |
| West Virginia | 147,800 | 11,031 | 161,500 | 6,964 | 24,900 | 4,508 | 54,731 |
| Wisconsin | 174,600 | 31,510 | 232,000 | 13,378 | 42,500 | 9,843 | 3,270 |
| Wyoming | 15,400 | 1,800 | 15,400 | 921 | 1,500 | 459 | |
| Total | 6,392,300 | 868,767 | 6,174,500 | 388,393 | 1,692,700 | 393,090 | 1,650,220 |

[1] Figures for Virginia estimated on basis of costs in adjacent States because of inadequate surveys. They are included in order to obtain national totals.

TABLE 13.—*Estimated values of materials and labor required for needed water works and sewerage works*

| Type of material | Millions of dollars | | |
|---|---|---|---|
| | Sewerage works | Water works | Total |
| Stone, clay, and glass products: | | | |
| Concrete, including premixed | 138 | 67 | 205 |
| Brick, hollow tile, sewer pipe, etc | 328 | 58 | 386 |
| Cement | 85 | 58 | 143 |
| Sand, stone, glass, clay, etc | 126 | 63 | 189 |
| Total | 677 | 246 | 923 |
| Iron and steel, and their products: | | | |
| Pipe and fittings, iron and steel | 163 | 451 | 614 |
| Other steel and iron products | 247 | 173 | 420 |
| Total | 410 | 624 | 1,034 |
| Machinery: | | | |
| Pumps and pumping equipment | 70 | 59 | 129 |
| Engines and turbines | 50 | 31 | 81 |
| Electric machinery, apparatus, and supplies | 25 | 17 | 42 |
| Other foundry and machine-shop products | 49 | 28 | 77 |
| Total | 194 | 135 | 329 |
| Forest products | 140 | 143 | 283 |
| Chemicals (paints, explosives, etc.) | 20 | 20 | 40 |
| Nonferrous metal products | 19 | 37 | 56 |
| Miscellaneous materials: | | | |
| Electrical wiring and fixtures | 39 | 20 | 59 |
| All other materials | 65 | 54 | 119 |
| Total | 104 | 74 | 178 |
| Total, materials, all types | 1,564 | 1,279 | 2,843 |
| Labor (on site) | 1,246 | 558 | 1,804 |
| Other expenses (land, engineering, legal, financing, and profit) | 939 | 432 | 1,371 |
| Total | 3,749 | 2,269 | 6,018 |

Source: Based on studies of U. S. Department of Labor, Bureau of Labor Statistics.

## DISCUSSION OF NATIONAL SANITATION PROBLEMS

These are the needs of the country in the fields of water supply and waste disposal facilities—the most basic requirements of a sanitary environment. What should be done to provide them and what are the problems to be solved in meeting these needs?

Some of these requirements are merely the result of normal growth and expansion of cities. During the war, much public work was necessarily deferred. Comparatively few problems of more than local concern are presented by this type of need. A recently completed survey of the Twentieth Century Fund (*9*) indicates an accumulated wartime deficiency of 353 million dollars' worth of sewerage work and 95 million dollars' worth of water work, based on a comparison of rates of expenditure during the defense and war period with those during the period 1935–39. This estimate appears to be low, considering the much larger amounts of work for which plans are available. The long-continued difficulty of obtaining materials, the high cost of construction, and the unwillingness of governments to enter into competition for materials and labor necessary for housing, have made most communities continue to defer all but emergency work. As the present housing emergency is met and construction costs become more stable, the work now ready for construction will be started at an accelerated rate. This trend is evident already. During the first half of 1947 the volume of water and sewerage works construction was about 30 percent greater than for the corresponding period in 1946. Although some of these projects may require a considerable time for completion, it seems probable that most of them, together with most of the work for which plans are being prepared, will be completed within the next 5 years. Although it is difficult to predict the pace at which this construction will be carried out, a rate of expenditure exceeding any attained in the past 20 years probably will be reached when materials and labor become readily available.

### METROPOLITAN AREAS

All of our cities, but particularly the larger ones, are faced with a variety of problems affecting the health of the people and arising from the centrifugal movement of population, the development of blight and slums, and the decrease in real estate tax returns. This movement to outlying sections, where land values are lower, increases the cost of sanitation facilities as it does the cost of most other municipal facilities and services. Likewise, it requires expensive rearrangements and enlargements of water and sewerage systems to serve the newly developing areas without any corresponding decrease in the necessary facilities in the blighted areas. Although our largest cities are the source of much of our wealth, and although incomes are generally much higher in these cities than in smaller towns and rural

areas, the financial problems confronting practically all of our large cities are acute.

Fortunately, the provision of these needed sanitation facilities is less seriously affected by the financial plight of the cities than are many other essential municipal functions. Water supply, sewerage, and refuse disposal services are public utilities which can be, and in fact are in many places, operated as private enterprises with charges based on the service rendered. Municipal water supplies are financed almost universally by revenue from water users. In the cases of sewerage and refuse disposal, the practice of charging directly for the service is less general but is growing in order to avoid increases in property taxes which would otherwise be necessary. The majority of the States permit cities to make such charges. A few do not. In other States various defects in the laws preclude the use of this method of financing. Correction of these defects will make it easier for the cities to provide needed sanitation facilities and services without increasing already overburdened tax sources.

## FRINGE AREAS

In addition to the problems of large cities traceable to the forces of decentralization, these same forces are giving rise to many problems in newly developed suburban areas where unplanned or poorly planned communities give promise of becoming the slums of tomorrow. To a considerable extent the provision of adequate sanitation facilities is a crucial problem upon which the success or failure of these developing areas will depend.

Much of the housing now being built is located in unincorporated areas where water supply facilities are available or can be provided by extension of mains. The charge for water service based on water use can be readily levied and collected, relieving the real estate developer of any continuing responsibility. In many places, however, even public water supply facilities are not being provided, although building lots are so small that safe water supplies cannot be obtained on the property. The problems of sewerage and disposal of refuse are more complicated. Frequently, topography complicates the problem; for example, where a newly developed area does not drain toward existing sewers. In many instances, although a city can provide and collect for water service to areas outside its borders, no administrative machinery is readily available for payment of the costs of sewerage or refuse disposal service to such areas.

In many of these new subdivisions individual sewage disposal systems are being installed. These consist usually of septic tanks of varying sizes and designs and soil absorption systems or underground filters for disposal of the liquid wastes. Where ample land is available, soil, ground water, and drainage conditions suitable, and the systems adequately designed and carefully installed, this method of

sewage disposal can be quite satisfactory, if the facilities receive periodic attention and maintenance. Unfortunately, this combination of circumstances is frequently not found or provided, particularly where lot sizes approach those usual in cities. As a result, insanitary conditions develop which are not only detrimental to health but cause property values to decline. In these same areas garbage and refuse disposal facilities are frequently primitive and not subject to effective regulation in the interest of health.

A number of measures can be taken to deal with these problems. In some States the laws effectively prevent the provision of adequate sanitary facilities by failing to provide administrative machinery for financing, building, and operating them. Various methods can be used. Which one is the best depends upon local conditions. In some instances a nearby community could provide the facilities and services, if given the power to collect for them. A special sanitary district would be preferable for some situations. In other cases, existing political subdivisions, such as the county, would be the best agency for providing the service.

In many metropolitan areas, there is no political subdivision outside the larger cities with authority to control the subdivision of land or the type of housing and sanitary facilities provided. Although the cities generally have such powers through zoning laws and otherwise, the States have been slow to provide similar powers to counties. Health departments, either State or local, if given proper authority and adequate staffs, can exercise some control over poorly conceived developments. In many States, however, the health departments have little or no power to act until a nuisance has developed or until an outbreak of disease actually occurs as a result of the poor sanitation facilities. By this time the damage has been done. The householder has been put to considerable expense, and the task of correction is much more difficult and expensive than the provision of proper facilities would have been in the beginning. In other States, although the laws are adequate, the health departments are so understaffed that they cannot review plans or inspect the facilities while under construction, to insure compliance with good practice.

One of the difficulties that has faced the health departments in attempting to improve the sanitation of individual household sewage disposal systems, has been that relatively little research has been done on which to base a sound engineering design of various elements of these systems. Consequently, health authorities have not been in a strong position when faced with the problem of approving or rejecting new designs. Although there has been a wealth of experience with various types of installations, very little objective study has been given the problem. Existing design standards are frequently the result of a compromise of expert opinions, rather than being based on sound research.

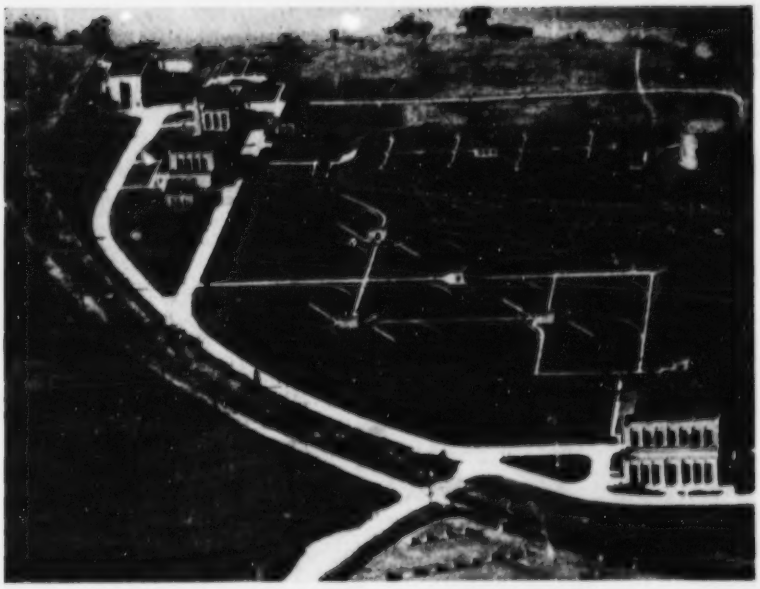


FIGURE 12.—Air view of Washington, D. C., Sewage Treatment Plant.

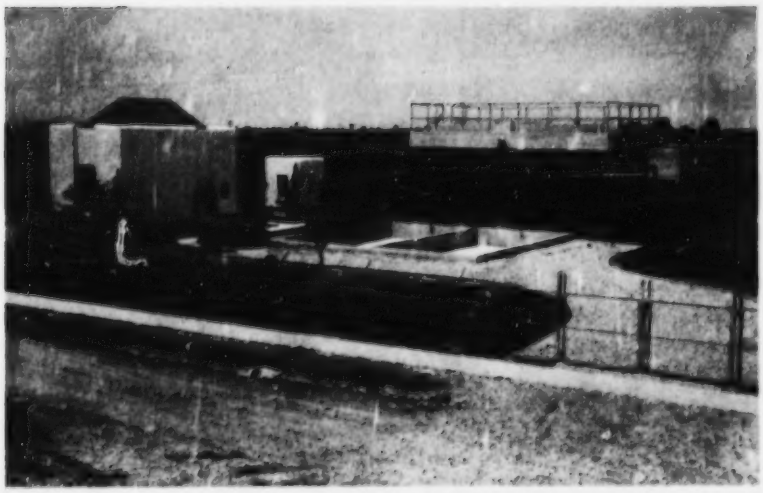


FIGURE 13.—Arcadia Parish sewage disposal plant, Rayne, Pa.

FIGURE 14.—Construction of trunk sewer, Fairfax County, Alexandria, Va.

FIGURE 15.—Construction of sewer line, Charleston, S. C.

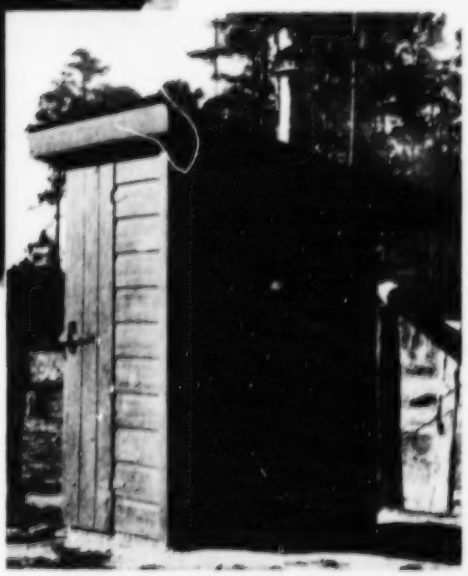


FIGURE 16.—Privy on farmstead near Marshall, Tex.

The Sanitary Engineering Division of the United States Public Health Service is cooperating with the United States Housing and Home Finance Agency in a study aimed at improving the design of individual household sewage disposal systems. It is hoped that this study will provide the necessary basic information to enable State and local health authorities to make sound decisions as to the suitability of various types of systems. It should also enable the manufacturers of septic tanks to revise their designs where they are inadequate.

## SMALL COMMUNITIES

In large communities, public water and sewerage systems are indispensable. In the small towns water can frequently be obtained from private wells or cisterns. Wastes can be disposed of by means of privies, septic tanks, or other methods. However, the more thickly populated the community, the greater is the difficulty of preventing pollution of these private water supplies and of disposing of wastes without nuisance or danger to health. In these small communities which are not served by public water and sewerage systems the incidence of filth diseases remains high.

With the exception of the larger cities in the population group over 100,000 the per capita cost of providing the needed facilities increases as the the size of the town decreases. (See fig. 5.) At the same time the financial capacity of these smaller towns is less than that of the larger communities. Table 14 shows a comparison of the cost of needs as related to income in various sized communities in a few States typifying different sections of the country.

TABLE 14.—*Per capita water and sewerage works needs as compared with per capita spendable income* [1] *for selected States and sizes of community*

| Size of community | Alabama | Iowa | Minnesota | New York | Oregon | Washington |
|---|---|---|---|---|---|---|
| 200–500 population: | | | | | | |
| Per capita income | $370 | $974 | $720 | $1,247 | $1,186 | $1,279 |
| Per capita needs | 101 | 196 | 254 | 303 | 141 | 198 |
| Percent (needs/income) | 27 | 20 | 35 | 24 | 12 | 16 |
| 5,000–10,000 population: | | | | | | |
| Per capita income | $552 | $985 | $920 | $1,358 | $1,320 | $1,252 |
| Per capita needs | 45 | 33 | 63 | 47 | 74 | 102 |
| Percent (needs/income) | 8 | 3 | 7 | 4 | 6 | 8 |
| 100,000–1,000,000 population: | | | | | | |
| Per capita income | $1,106 | $1,805 | $1,539 | $1,239 | $1,999 | $1,998 |
| Per capita needs | 13 | 33 | 16 | 16 | 48 | 40 |
| Percent (needs/income) | 1 | 2 | 1 | 1 | 2 | 2 |

[1] Data on per capita spendable income from Sales Management, August 1945. Income figures are for counties. It has been assumed that county average is representative of income of towns with the county. Only those communities having some needs are included.

These figures indicate how much larger a percentage of the communities' income will be required in the smaller towns than in the larger towns and cities. The financial burden has been one of the most important deterrents to the installation of public water supplies and sewage systems in small communities. However, the fact that more

than one-third of the communities with less than 1,000 population have water systems indicates that cost is not always an insurmountable barrier. Federal financial assistance which was available during the 1930's made it possible for many of these communities, which could not otherwise have afforded water systems, to obtain them. It seems probable that some financial subsidy will be required if the needs of these small communities are to be met within a short time. The benefit to the entire country of eliminating these foci of waterborne disease, which can spread beyond the point of origin, would justify such subsidies.

A number of European countries, including Sweden and Great Britain, follow the practice of subsidizing water and sewerage systems in small communities and rural areas. In England both the county and the central government assist the community. The aid of the central government is contingent upon similar assistance from the county. Since 1929, financial aid has been available. It was estimated in 1944, when the latest law on the subject was passed, that about 3 million people in England and Wales (7 percent of the total population) were not served by piped water supplies. The 1944 legislation provided approximately 60 million dollars to subsidize postwar work to provide water systems for these people. Shortages of materials and the acuteness of the housing problem have prevented much progress under this program. But by early 1947, projects estimated to cost over 80 million dollars had been submitted to the Ministry of Health for review and projects totaling some 16 million dollars had been approved.

It is difficult to say what form of subsidy would be most effective and efficient in this country. Low interest rate loans, similar to those available for rural electrification under the REA program, would probably give impetus to needed water and sewerage work in the small communities. Interest rates to the larger cities are lower than ever before, but the smaller towns have not fared so well. Government guarantees of the towns' bonds, similar to the guarantees available for housing under the GI bill of rights, might provide the needed stimulus. On the other hand, direct grants might be the most effective type of subsidy. Greater use could be made of State aid to these communities. The assistance does not necessarily have to be from the Federal Government.

Strengthening the staffs of the State health departments would provide a kind of indirect subsidy by permitting these agencies to furnish better service to the communities. It has long been a function of the health departments to promote the installation of community water and sewerage systems, by acquainting the people with the need for such utilities, and by assisting municipal officials to take the necessary action to obtain them. The lack of qualified engineers is hampering such work. Certainly the cheapest method of assisting

communities would be to provide funds to hire additional health department personnel.

Designing and supervising the construction of water and sewerage systems have been traditionally the field of the consulting engineer, except where municipal engineering departments are large enough and include specialists competent to undertake such work. This practice should be preserved. The cost of competent engineering service is frequently so high that the small community may hesitate to call upon a consultant for preliminary studies and designs. In turn, the consulting engineer hesitates to accept such work because it is generally unprofitable.

Health agencies and other governmental agencies can help to solve this problem by providing some of the basic engineering information which is usually available in larger communities but frequently lacking in the smaller villages. Loans or grants to communities to enable them to engage qualified consulting engineers have been tried by the Federal Government and by some of the States. Such aid has been helpful in promoting advance planning of sound public works. It is inevitable, however, that this method alone will not entirely solve the problem of the small community unless it is given a relatively greater amount of assistance than the larger town. The small village's work will still be less attractive financially to the private consulting engineer than that of the larger community. Some solution must be found which will tend to equalize the ability of these small rural communities to obtain expert engineering advice with that of the larger towns.

Many communities have attempted to save money by retaining the least expensive engineers available to plan and supervise construction of their water and sewerage works. The result almost invariably is a system which is more costly to maintain and operate, and which gives less satisfactory service than those to which the engineers have been able to devote enough time and study to the communities' problems to enable them to fit the systems to the special needs and conditions of the community. Experience has proved beyond a doubt that "cheap" engineering is actually the most expensive.

## UNINCORPORATED COMMUNITIES

The unincorporated community presents a few special problems which arise principally from the lack of community organization and of proper legal and administrative machinery to enable the people to obtain the facilities they need. The same laws that are necessary to deal effectively with the problems of the fringes of metropolitan areas, are necessary to enable unincorporated communities generally to obtain satisfactory water, sewerage, and refuse disposal service. Fortunately, all of these needs can be financed wholly or largely by direct charges against those who receive service. Such

needs can thus be provided, without affecting the bonded indebtedness of the political subdivision providing the service, and without resort to property taxes, if laws for revenue financing are available.

An appreciable percentage of our unincorporated communities are "company" towns associated with some industry, such as a mine, a textile mill, or other enterprise. Although the sanitation facilities in such towns vary greatly, more of them are provided with public water supplies than are other unincorporated communities. Water is generally needed by the industry and can be furnished to the workers' homes at a cost which is usually reasonably low. On the other hand, sewers are seldom provided in such towns, and sewage treatment almost never.

The recent report of the Coal Mines Administration on its medical survey of the bituminous-coal industry depicts clearly the sanitation conditions in coal-mining communities, analyzes the causes of some of the lacks, and makes a number of sound recommendations for action by the companies, the workers, and by various public and private agencies to improve conditions. The report points out the inadequacy of the laws of many of the coal-mining States to deal with sanitation problems in these communities and the inadequacy of the funds available to State and county health departments to implement properly the laws that are available. In these towns as elsewhere the primary responsibility is and should be with the local population. There is also a need for action by outside individuals and groups to assist the people in getting the basic requirements of a sanitary environment.

Although sanitation needs in coal-mining communities have received more attention than those of other small towns, the differences between them are not basic. The fundamental problems are much the same, and methods of overcoming them will be similar.

### RURAL AREAS

In general it is in the rural areas that water and waste disposal facilities are least satisfactory. The 1940 census of housing showed that more than 1½ million rural homes had no source of water supply within 50 feet of the house, and that more than 900,000 had not even an outside toilet or privy for disposal of human wastes. Modern plumbing, which is taken for granted by the urban dweller, is found in less than one-eighth of our farm homes. These figures take no cognizance of the sanitary quality of water supplies nor of whether wastes are disposed of in a sanitary manner. On the basis of bacteriological and chemical tests and sanitary surveys of large numbers of individual water supplies by several State health departments, it has been found that more than 75 percent of these supplies are unsafe. An even larger percentage of the privies are insanitary, either due to improper construction or location, or to inadequate maintenance.

There is a clear relationship between these insanitary conditions and the fact that our highest death rates from diarrhea, dysentery, and typhoid fever are in areas not served by public water supplies or sewers.

The task of providing the needed facilities in these areas, where community facilities are impracticable, is one of the most pressing and most difficult tasks confronting health workers. Many people still do not understand or appreciate the importance of protecting their water supplies from pollution nor the many ways in which improper construction of wells can result in contamination of the water. Unsafe water seldom gives warning of its impurity. Yet to many people the fact that a well has been used for a period of years without serious illness is ample evidence of the safety and purity of the water. Conveniently overlooked or forgotten are the frequent attacks of "intestinal flu" or "upset stomach" which incapacitated members of the family without apparent cause. Serious illness strikes only infrequently and when the right combination of circumstances arises. Even then the occurrence may pass unnoticed if only a single household is involved—except for the recording of another case of typhoid fever or another death from infant diarrhea.

The difficulty of overcoming this attitude is reflected in the decision of one of our State supreme courts a few years ago. It was decided that the fact that a State institution had not experienced any waterborne typhoid fever over a period of 8 years was good evidence of the safety of its water supply, in spite of frequent warnings from the health authorities that the supply was unsafe. This astounding decision was made after a typhoid fever epidemic had struck 453 people and killed 60.

The need is apparent for more educational work on the part of all of our health agencies and others to acquaint the people with the necessity of adequately safeguarded water supplies and sanitary methods of waste disposal. Technical assistance should be available through the county sanitary engineer to aid these people in obtaining the facilities they need. Additional research is necessary to improve the methods and equipment used in this work and to reduce costs.

Although a well or cistern with a hand pump and a sanitary type of privy are considered the minimum facilities necessary, it must be recognized that it is difficult under modern living conditions (though not impossible) to maintain a sanitary environment without running water under pressure, and bathing and toilet facilities in the home. Extension of rural electrification has played an important part in making it possible for the rural family to obtain these advantages, and further progress can be expected as electric service becomes available to more rural homes.

A survey by Successful Farming made in 1944 showed that running water and modern plumbing rank with electric refrigerators at the top